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A Reinforced-Concrete Wharf with Grouted Foundations; Harbor Improvement at Iloilo, Philippine Islands

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The city of Iloilo is situated on the southern coast of the island of Panay, about 330 miles south of Manila, and is one of the five ports of entry in the Philippine Islands. The principal export is sugar, which is shipped to Chinese ports and to the United States.

The commerce of Iloilo in round numbers for an average year is indicated by the following figures:

Foreign clearances, 140; displacement, 206,000 tons.
Coastwise clearances, 3700; displacement, 212,000 tons.
Total clearances, 3840; displacement, 418,000 tons.
Customs collections per year are about $700,000.

Practically one-half of the business of the port is carried on in vessels averaging less than 60 tons displacement.

Facilities

The harbor of Iloilo comprises the Iloilo River, and Iloilo Strait, the latter being a good anchorage at the mouth of Iloilo River, and protected by the islands of Panay and Guimaras. Previous to the present improvements nearly all the foreign cargoes were handled by lighters between the ships in the Straits and the warehouses on the river.

Iloilo River is not a river in the strict sense of the term, but is a tortuous tidal estuary, the lower 9000 ft. of which is navigable and available for shipping. This portion is in the shape of a huge letter S, and naturally divides itself into three reaches, each approximately 3000 ft. in length. In former times the lower reach was merely a channel through tide flats, but at various times in recent years this reach has been improved by dredging, the material being deposited on the banks on either side, until at the present time it exists as a definite stream, 400 to 500 ft. in width, flowing between permanent banks, and discharging into Iloilo Straits between two riprap jetties.

The only docking facilities available previous to 1908 were on the middle reach of the river, where most of the warehouses are situated. A marginal street varying in width from 30 to 60 ft. extended the whole length of this reach, and it was supported on the river side by a light adobe-stone retaining wall, founded on the natural soil at about low-tide level, and consequently only light craft could moor directly alongside, steamers being obliged to stand off, and passengers and cargo handled over long stage planks between the wall and ship (Fig. 1). The depth on this reach was from 15 to 18 ft. at low tide.

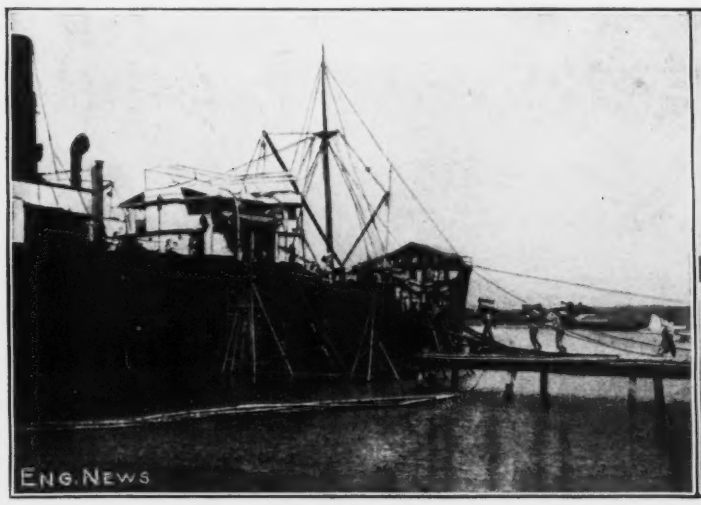

Fig. 1. Old Method of Loading Sugar into Ocean-Going Steamers

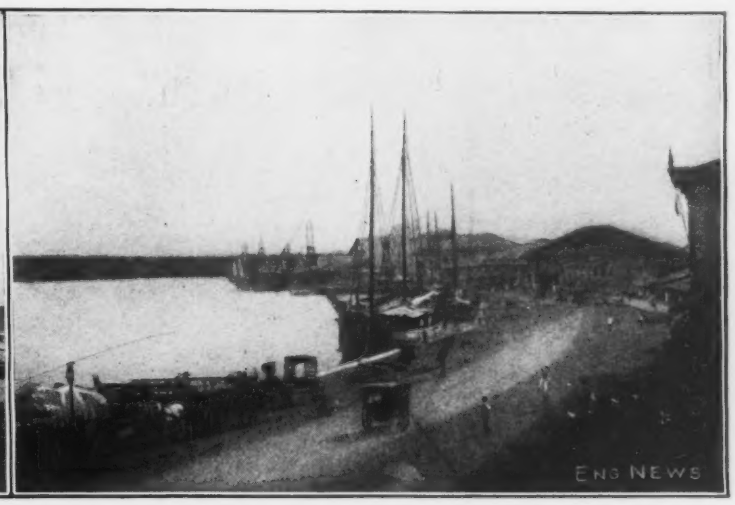

Fig. 2. Completed Quay and Marginal Street along Iloilo River

Figs. 1 and 2. Iloilo Harbor, P. I., before and after Harbor Improvements

Improvements

The first improvement at Iloilo under the American occupation was to dredge the middle and lower reaches to 18 ft. at low water, using the dredged material to fill low land on the left bank of the river, opposite the city, and an area on the right bank on the lower reach, retaining the fill and protecting the river channel by dikes of small riprap stone (Fig. 5) and building riprap jetties on either side of the river at its mouth. The fill on the left bank of the lower reach is now occupied by the Iloilo terminal of the Panay Division of the Philippine Ry. Co., a line 70 mi. long terminating at Capiz, on the

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north coast of the island of Panay. The opposite fill has become a valuable site for warehouses.

The present improvement, undertaken in 1908, contemplates a definite development, and provides a 15-ft. depth at low water in the upper reach, 18 ft. in the middle reach, and 24 ft. in the lower reach. The entire river was deepened to these figures in 1910. These depths are probably the greatest which it is advisable to attempt to maintain in the respective reaches.

The material dredged from the river at this time was used to extend the previously filled areas owned by the Insular Government, and to improve several low-lying areas within the city, and also to reclaim a considerable area of beach on the left bank of the river, fronting Iloilo Straits, and adjoining the railway terminal. It is proposed to develop this area by building a series of docks and slips where steamers drawing 30 ft. can berth, and to lease the property for warehouses or other purposes, at the proper time. It is expected that the rich valley lands in the interior of the island of Panay will soon begin to produce sugar on a large scale, and the improved facilities offered of direct railway transportation to the wharves of ocean-going steamers, in lieu of the present trans-shipment necessary from Negros, will stimulate the industry as it deserves.

This dredging was done by contract by the Atlantic, Gulf, and Pacific Co., of Manila, at 23¼c. per cu.m., and the amount of material paid for was over 900,000 cu.m.

Quay Walls

For the quay walls a retaining wall was first built but was later folowed by a reinforced-concrete wharf.

Concrete Retaining Wall

The second step of this improvement consists in the building of suitable quay walls along the river as funds become available, and the most urgent requirement was the replacing of the old wall on the middle reach by a new structure approximately parallel to it and in front of it, alongside of which vessels drawing 18 ft. could lie at all stages of tide, at the same time providing a marginal street with a uniform width of 80 ft. the whole length of the improvement (Fig. 2).

A contract was let by the Insular Government for the construction of a gravity-concrete retaining wall upon timber piles, but after doing a very small amount of work and making unsatisfactory progress, the contract was annulled, the contractor's plant purchased, and the work was completed by Government administration. The unit prices paid under the contract were as follows:

Piles, driven and cut off in place, per lin.ft.	$0.625
Concrete, per cu.yd.	9.25
Riprap stone, per cu.yd.	1.50
Backfill, between new wall and old street, per cu.yd.	0.625
Mooring posts, cast iron, each	150.00
Mooring cleats, cast iron, each	37.50

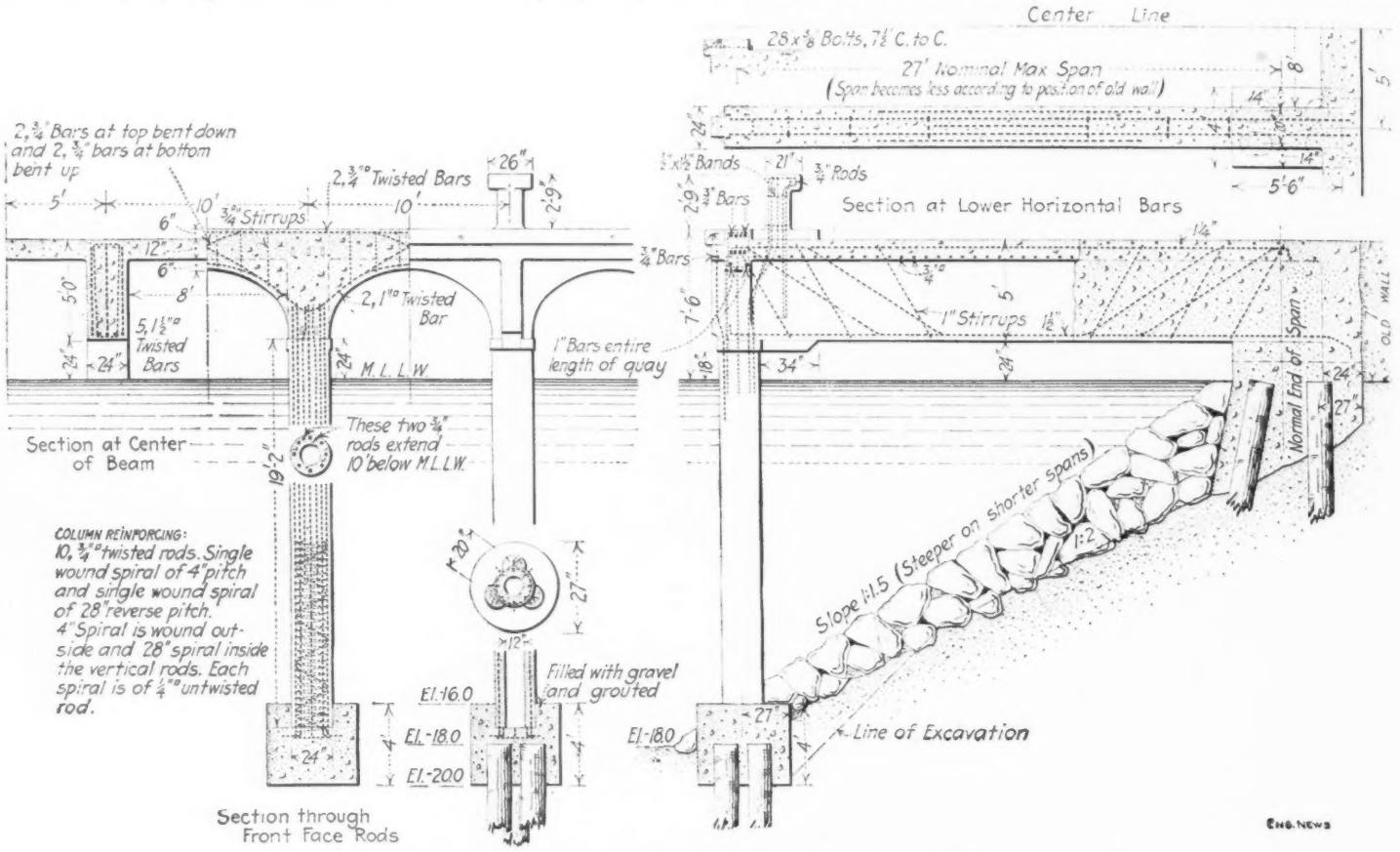
Center Line
28 x ⅞ Bolts, 7½" C. to C.
27' Nominal Max Span
(Span becomes less according to position of old wall)
Section at Lower Horizontal Bars
2, ¾" Bars at top bent down and 2, ¾" bars at bottom bent up
2, ¾" Twisted Bars
¾" Stirrups
2, 1" Twisted Bar
5, 1½" Twisted Bars
1" Bars entire length of quay
M.L.L.W.
Section at Center of Beam
These two ¾" rods extend 10' below M.L.L.W.
COLUMN REINFORCING:
10, ¾" twisted rods. Single wound spiral of 4" pitch and single wound spiral of 28" reverse pitch. 4" Spiral is wound outside and 28" spiral inside the vertical rods. Each spiral is of ¼" untwisted rod.
Filled with gravel and grouted
EL. 16.0
EL. 18.0
EL. 20.0
Section through Front Face Rods
1" Stirrups
Slope 1:1.5 (Steeper on Shorter Spans)
1:2
Line of Excavation
Normal End of Span
OLD WALL
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FIG. 3. DETAILS OF REINFORCED-CONCRETE WHARF

At these unit prices the wall, including the backfill, would have cost if finished by contract $155 per lin. ft., exclusive of any government supervision or inspection. Under government administration 792 lin. ft. of wall were completed at a cost of about $130 per lin. ft. including all local administration and superintendence, and including the backfill.

When this length of retaining wall had been completed a point was reached where the wall type of construction was becoming more expensive and troublesome on account of the proximity of the old retaining wall. The new wall has a bottom width of 15 ft. at the depth of 18 ft. below low water, and as it was necessary to dredge to that depth and width, the bank slope was not able to carry the old wall and the street behind it without considerable expensive shoring, and it was desirable to leave the old wall and its well compacted fill intact if possible.

The marginal street is occupied its whole length with storehouses and offices, and carries a heavy traffic which could not wholly be diverted during construction, and it was therefore essential to so conduct operations as to leave the street in use.

Reinforced-Concrete Wharf

Plans were accordingly prepared for a reinforced-concrete wharf structure which would take advantage of existing conditions to their fullest extent (Fig. 3). The wharf consists essentially of a series of transverse girders spaced 10 ft. apart, carrying a 12-in. reinforced-concrete floor. The outer ends of the girders are supported upon reinforced-concrete columns 24 in. in diameter and 19 ft. 8 in. long, cast in the yard, and set in place with a derrick upon a prepared timber pile footing 17 ft. 8 in. below low water. The inner ends of the girders are carried by concrete pedestals, at 2 ft. above low water, built against the old wall and carried only to the natural slope of the bank.

Rear Footings—Each rear pedestal is supported by from four to six timber piles, at least two of which are driven on a batter, the better to resist any horizontal thrust that may come from the old wall. This group of piles is driven to a total bearing of 80 tons, it being always desired to drive each pile to 20 tons if possible, but as it was frequently impossible to secure piles of sufficient length to develop that bearing, enough extra piles were added to insure the total required bearing power per group.

These pedestals vary in size and position according to the alignment of the old wall, and the number of piles necessary per group, but the size was usually dependent upon the position of the batter piles which were driven as close to the old wall as the leads of the driver in the battered position would allow. Connecting the pedestals is a concrete curtain wall, 2 ft. in thickness, which serves to strengthen the old wall. The curtain wall was built to the grade of the pedestals monolithic with them; above that grade it was poured at the same time as the girders and floor.

Front Footings—The most interesting and important feature of the work was the construction of the front foundations. The outer edge, or front of the wharf, as stated above, is carried by the line of reinforced-concrete columns, spaced 10 ft. apart, one under the outer end of each of the transverse girders. This line of columns is so placed as to give a uniform width of street from the front of the wharf back to the building line of 80 ft., and as there was considerable variation in the old street width out to the irregular line of the old wall, the spans of the main girders vary from 20 to 27 ft. The latter length was the maximum nominal span allowed in the design.

Each column is carried by a cluster of piles whose total bearing is not less than 60 tons. It was attempted to drive each pile to a bearing of 20 tons, and this was usually obtained, but often four piles, and sometimes five were required. The reason for requiring but 60 tons per group in the front footings while those in the rear were expected to develop 80 tons was due to the fact that it was uncertain what loads might come to the latter through the weakness of the old wall, and which those piles would have to carry in addition to the direct load from the new structure. When only three piles were required they were driven at the apexes of a 20-in. equilateral triangle. When four piles were necessary they were driven at the corners of a 20-in. square, and if a fifth pile was required it was driven in the center of the square. It could usually be foretold how many piles would be required for any column by the penetration secured in the last cluster driven, and if the number were under-estimated, those driven were at once sawed off at the proper grade, their positions carefully located by plumbing above the surface, and the additional pile needed was then driven in the most favorable position to give good spacing in the cluster. Since it is seldom possible to drive a pile to the exact location required it was necessary to use more than ordinary care in spotting these piles, and to hold them during driving, in order to keep them within proper limits. Frequently after locating the driven piles it would be found that one or more were so far out of position as to necessitate the driver returning to put in extra piles, those too far from line being excluded entirely from the foundation.

After the piles were driven and cut off, they were inclosed in a circular sheet-iron casing, $\frac{1}{16}$-in. metal, usually 54 in. in diameter, and 4 ft. high, so placed that its top was 2 ft. above the pile cutoff. To support the

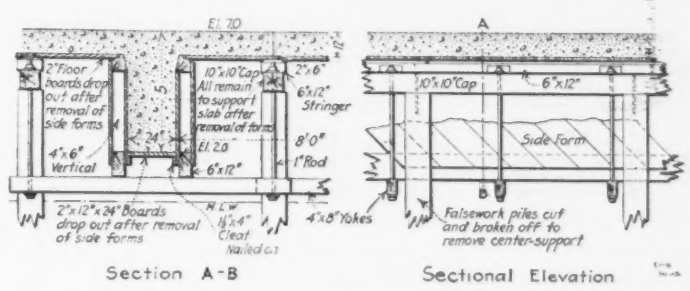


Fig. 4. Falsework and Forms for Wharf Construction

casing on the bottom it was necessary to throw small riprap stone around the piles until a firm bottom was made. To set the casings a wooden frame was provided, 4 ft. square and 22 ft. long, to the bottom end of which the casing was fastened with wire. The frame, or template, carrying the casing on its lower end, was then picked up by the derrick and set in place, a diver guiding the lower end to insure that the casing was at all points at least 6 in. distant from the side of any pile, while the top, being always above water, was directly under observation for line and grade. A gage, with its zero mark 16 ft. above the top of the casing was fastened to the frame, so that at any stage of tide the casing was easily set at the proper grade by noting that the gage on the frame read the same as the water height on the permanent gage.

After the casing was set to line and grade, concrete was placed in it by means of a canvas bag opening at the bottom, to a point 6 in. below the tops of the piles. When the concrete had set, a diver cut the wires holding the casing to the frame and the latter was removed.

Grouted Foundations—When the column was about to be placed, gravel was deposited in the casing to the grade of the bottom of the column, and the latter was then carefully set to line and grade and braced to the falsework, it resting meanwhile upon the gravel in the casing. Thin cement grout was then poured into the gravel through a 1-in. pipe carrying a funnel at its upper

end. As no pressure was used to force the grout into the gravel except the static head between the surface of the water and the upper end of the pipe, which was never greater than about 8 ft., it was found necessary to move the pipe around and grout at different points in the gravel to insure that the gravel was thoroughly cemented. After the gravel first placed was thus grouted, more gravel was deposited around the column to make a layer about 1 ft. thick, which was then grouted as before. It was found necessary to thus grout the gravel in layers, because in attempting to force the grouting pipe through any considerable thickness of gravel it became clogged, and the pressure was not great enough to clear it. When the casing had been filled with concrete in this manner, and had set at least 24 hours, the hollow interior of the column was pumped free of water, and then filled with concrete. The pumping of the interior served as a test of the grouting, for if any part of the gravel had not been thoroughly sealed, water would soon have appeared inside the column, and indicated defective work. All the columns were easily pumped by a small hand pump, and remained dry for an hour or more, before filling with concrete.

This method of building these footings was entirely satisfactory in every way, and there are probably many similar cases where small well confined foundations can be similarly treated, but on account of the richness of the concrete, and the unavoidable waste, due to some of the grout escaping, it would be expensive in a very large mass. In this case where it was necessary that a perfect result be obtained, several advantages are apparent. It obviated placing concrete under water, and it excluded the necessity of pumping and the coffer-dam method, which would have been out of the question for such small foundations.

The setting of the columns was rendered simple, as they were placed on the gravel in the casing, and so had sure support during the operation of filling the casing. The difficulties of setting columns on a bed of green concrete under water must be evident. The manipulation of the column while attaining line and grade would so agitate fresh concrete as to cause it to separate, or it would be necessary to support the column from above and then bring the concrete up to it. In the method described the column was lowered directly onto soft gravel which had previously been brought to the proper grade. If the column proved to be too low it was raised slightly and more gravel poured through the interior of the column. If too high, the column was dropped upon the gravel to compact it, or it was twisted and moved to work it into place and nothing was disturbed thereby.

That good concrete was made by this method was proved by experiment, and it is thus described in a report made at the time:

> An empty cement barrel (Fig. 10) was lowered into the same depth of water in which the footings are made, gravel placed therein by means of a 6-in. pipe to a depth of about 8 in., and then the grout pipe inserted into the gravel, care being taken to have the pipe coincide with the axis of the barrel. The gravel was then grouted in the same manner as is done in the foundation, more gravel placed in the barrel to the depth of about 12 in., and more grout poured, and so on until the barrel was filled with gravel and grouted. The sample was taken from the water after about 40 hr., the barrel was cut away, and the result was an entirely satisfactory block of concrete. Some very small pit holes appeared in the surface, but as a whole the surface was as smooth as is generally obtained in ordinary form work. The result shows that the grout will flow freely for at least 8 or 9 in. in all directions from the pipe. Eight buckets of grout were used in the barrel of gravel.

BACKFILL—After the columns were set riprap was placed along the front line of the wharf to a depth of 16 ft. below low water, and the slope back-filled to the tops of the rear foundation blocks with riprap and mud. The latter was to insure that the piles supporting the blocks would be fully protected from teredo, while the riprap was to make a stable and permanent slope and to prevent scour.

SUPERSTRUCTURE—The construction of the superstructure offered no unusual problems and followed usual practice in reinforced concrete. A length of 20 ft. of wharf, or two spans, was made at each operation, joints being broken in the center of the floor spans, a portion of the slab being figured to act with the girders as a T-beam. At expansion joints the break was made at the edge of the girders through the floor, thence along the rear side of the spandrel and through the center of the arch. The concrete mooring posts (Fig. 11) were cast in place at the same time as the wharf floor. They are located 60 ft. apart the whole length of the wharf. Mooring posts of concrete have been used at various places on work done by this office in the Philippines, and have proved satisfactory. As each mooring post contains less than one-third of a cubic yard of concrete, and about 100 lb. of reinforcing steel, they are much cheaper than the ordinary cast-iron posts or cleats, as witness the contract price bid for these articles above.

FALSEWORK—The whole construction was carried out by the use of falsework (Fig. 4). Bents of three or four piles each, as required by circumstances, were driven to grade 10 ft. apart midway between girders, and capped at 7 ft. above low water. From these caps the piles were driven for foundations by a skid driver. As the pile driver finished its work and moved ahead, the caps were removed, the piles cut off at 4.5 ft. above low water and recapped. From this trestle as a working platform the columns were set, and it also carried the forms for the superstructure.

It was not feasible to operate the driver on this low trestle as it was not only below high tides twice every day, but the driver had to work partially on the old street to maneuver for position to drive the batter piles, hence it was necessary to have the trestle at that elevation for driving, while to carry the forms for the superstructure it was necessary to cut off below the under side of the deck. All but the outside piles of each bent were lost, it being of course impossible to recover them after the superstructure was built. A feature of the falsework was its arrangement whereby a support was left under the center of the floor slab after the remainder of the forms were removed. Forms were removed from the girders and slabs after seven days, but the center support was left at least 14 days, and in most cases longer.

CONSTRUCTION EQUIPMENT

The pile driver used was of special design in order to drive the batter piles (Fig. 9). The head block was supported by the ordinary four-legged tower, 36 ft. high, but the two forward legs were spread outward at the bottom to give a batter of one horizontal to five vertical. Two brace legs extended backward from the vertical legs at the rear of the head block. The head block overhung the front battered legs about fifteen inches and carried

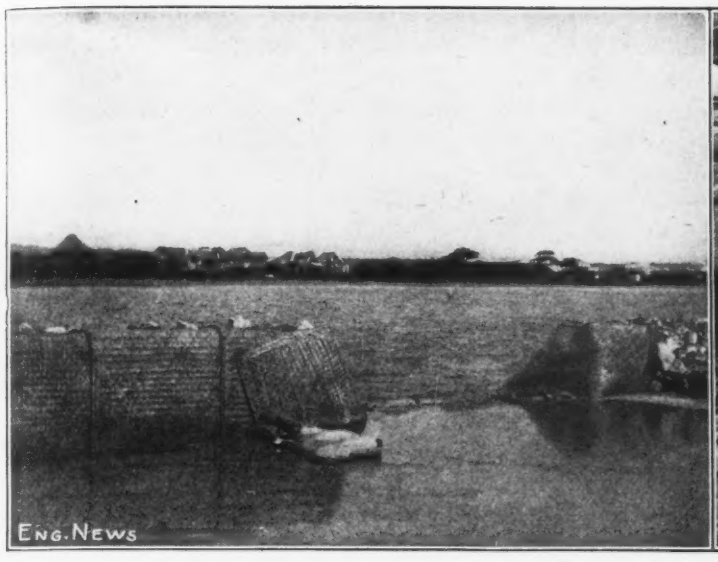


FIG. 5. STONE DIKE BACKED BY MATS OF SPLIT BAMBOO, IMPROVEMENT OF ILOILO RIVER

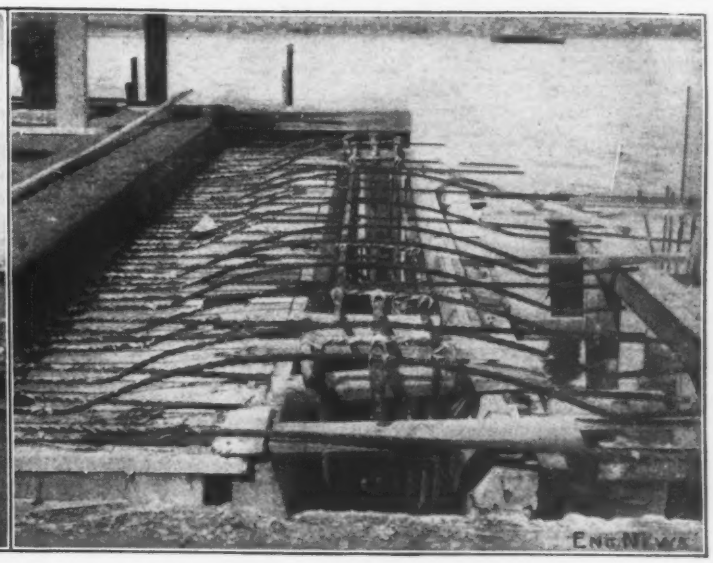


FIG. 6. BEAM AND FLOOR REINFORCEMENT OF WHARF

FIG. 7. CONCRETE COLUMNS IN CASTING YARD WITH ASSEMBLED FORM

FIG. 8. VIEW OF COMPLETED WHARF

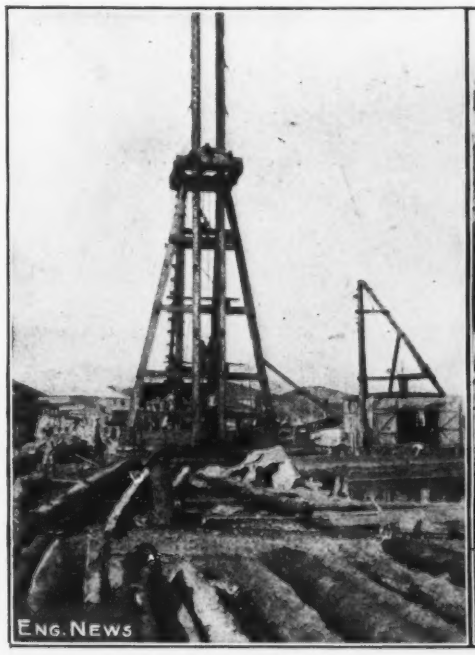


FIG. 9. FRONT VIEW OF PILE-DRIVER WITH LEADS RAISED

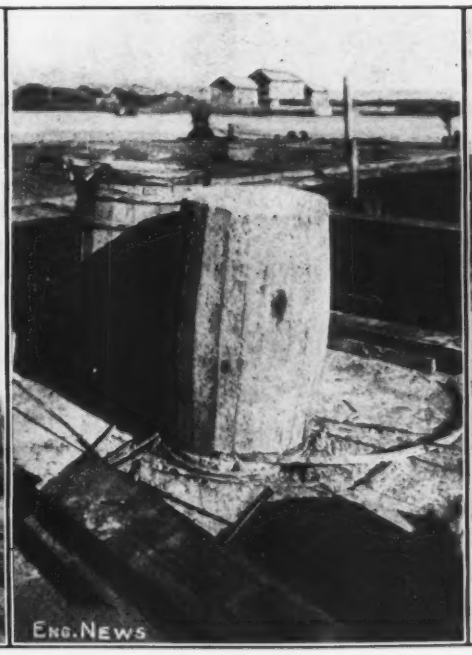


FIG. 10. CONCRETE MADE UNDER WATER BY POURING NEAT CEMENT GROUT INTO GRAVEL

FIG. 11. A REINFORCED-CONCRETE MOORING POST ON THE ILOILO WHARF

the swinging leads. The leads were made as light as possible consistent with their duty and were of single 3x12-in. yellow pine, with angle-iron hammer guides, and were 65 ft. long. They were connected together at the bottom by a timber yoke, and at three other points in the lower half of their length by yokes of strap iron, and were fastened again at their tops. No connections were possible in the upper half-length of the leads as they had to be free to slide up and down over the sheaves in the head block.

The head block carried two sheaves as usual, the second for a messenger line for snaking piles, etc., and it also was used to raise and lower, and to swing the leads. While driving, the leads were lowered and rested on the bottom, but while moving the driver their weight was taken by the head block by means of hooks on the leads resting over sticks across the head frame. The leads were swung to the battered position by simply taking the messenger line through a snatch block at the proper side and pulling them over at the bottom.

After a pile had been driven until its head reached the surface of the water, a follower was used which carried a hood that fitted snugly over the top of the pile, and was guided in the leads by a yoke at either end. Considerable time was consumed in placing the follower in the leads and removing it, but the results obtained by the rigid holding of the head of the pile in the leads justified any extra time taken. Before driving, every pile was carefully trimmed and fitted with a driving ring. The weight of the hammer was 3000 lb.

Other equipment comprised a floating derrick, to which could be rigged an orange-peel bucket for dredging; a 100-ton scow about 22x50 ft., used for hauling stone, lightering cement, etc.; and a small scow about 15x20 ft.

A well equipped blacksmith shop made pile rings, bolts, straps, etc., bent reinforcing steel, and did all minor repairs, but machine work was done by the local shops.

Materials, Methods and Costs

Concrete—Concrete was mixed by hand and shoveled directly into the forms. The concrete in the girders and floor was mixed on the floor last in place. The bottom of the main girders was only 2 ft. above low water, but no attempt was made to make the forms for them watertight, work being so arranged as to begin concreting on a falling tide as soon as the form could be cleaned after the tide had left it, and by the time the rising tide had reached the concrete it had been in place long enough so that no injury was done to it. In order to carry on the concreting it was frequently necessary to work during a part of the night.

The concrete in the rear footings was deposited under water by means of a 6-in. tremie, and it proved more satisfactory to finish the tops of the pedestals under water at high tide, than to finish them in the dry at low water. The top of the finished pedestals was only 2 ft. above low water, and when it was attempted to finish them in the dry, the wash from passing launches so washed the concrete as to make it extremely difficult to get good results.

Sand and gravel were piled always near the mixing platform, and were brought to it by men working in pairs carrying the materials in half cement barrels slung by wire from a pole across their shoulders.

All reinforced concrete was mixed in the proportion of 1 : 2 : 4, while that placed in the foundations under water was proportioned 1 : 2½ : 5.

Cement came from the works of the Green Island Portland Cement Co., near Hongkong, and cost $2.45 per barrel at ship's side in Iloilo. All cement was tested to the ordinary requirements by the local office as soon as it arrived. The sampling and testing were done by a Filipino employee who had received instruction in that regard during previous work by this office.

Sand and Gravel—Sand was brought from the beach in front of the town in native boats, carrying about 8 cu.yd. each, and was delivered screened at 32½c. per cu.yd.

Beach gravel came by sea from a point about 8 miles away in native sailing paraos, carrying from 4 to 8 yds. each, and cost $1 per cu.yd. delivered.

Riprap was purchased from a limestone quarry about two miles distant, on the island of Guimaras, directly across the straits from Iloilo. 50c. per cu.yd. was paid loaded on the 100-ton scow at the quarry, the Government furnishing the towing each way; or 65c. per cu.yd. was paid when the stone was delivered in paraos.

Timber—Piles were of native timber, a fairly hard, heavy wood, called "bacao," that does not float, consequently adding somewhat to the labor as it was necessary to buoy them with a bamboo or pine raft when handling them in the water. They were received in sailing vessels of from 50 to 80 in a cargo, from the neighboring island of Negros, and cost delivered from 14 to 18c. per lineal foot, in lengths from 35 to 45 ft.

Native lumber was used in concrete forms and all other cases except that some Oregon pine was obtained for pile caps. Native lumber for ordinary purposes cost $30 per M. ft. b.m., while hard woods for permanent use under water where teredo were to be resisted cost from $60 to $100 per M. Oregon pine could be purchased for $30 per M. and upward, but it is the policy of the Insular Government to use native woods as far as possible, and the use of Oregon pine is strongly discouraged.

Unit Costs—The following are some of the unit costs upon this work, taken from an actual monthly cost record shortly before the completion of the work.

	Each	Per lin.ft.	Per lin.ft. of wharf	Per sq.ft. of wharf	Per cu.yd.
Excavation			$3.90		
Piles	$15.51	$0.26	14.77		
Columns	107.37		10.73		$22.41
Abutments—concrete	71.15		7.12		6.56
Floor			29.23	$1.10	13.25
Riprap			3.24	0.12	2.48
Fender		1.36	1.36		
Wharf complete			70.35	2.81	12.35

Labor

Nearly all the labor on this work was done by Filipinos, under a single American foreman. There were on the rolls a Japanese blacksmith, and at times three or four Japanese or Chinese blacksmith helpers and carpenters. The pile-driver engineer was a Filipino, and as good an operator as could be desired, although he was not always as capable of keeping his engine in condition, or of making repairs as a white. Night watchmen were East Indian Sikhs, tall, bearded, white-turbaned men, who had usually seen service in the British Indian Army. These men are found everywhere in the East, and seldom work except as watchmen.

Each gang worked under a Filipino gang boss but it was always necessary for the American foreman to keep

in close touch with every detail. This work was well adapted to native labor as it could run in a more or less routine fashion, and the Oriental is not at his best when something new is continually arising.

The following daily rates were paid for labor:

Blacksmith, Japanese	$2.00 to
Blacksmith, helpers	0.75 to $1.25
Carpenters, Japanese and Chinese	1.50 to 1.75
Carpenters, Filipino	1.00 to 1.50
Foremen, Filipino	1.25 to 1.75
Piledriver engineer, Filipino	1.75
Derrick engineer, Filipino	1.00 to 1.50
Divers, Filipino	1.00
Laborers, firemen, watchmen, etc	0.30 to 0.75

To those unacquainted with work in the tropics, some of the methods employed must appear very crude. For example, there were over 27,000 cu.yd. of backfill placed behind the retaining wall described in the first part of this article. The material of which this was composed was sand from immediately across the river, about 400 ft. distant. All of this backfill was placed by natives using small dug-outs, or "bancas," of from one to three cubic yards capacity to transport the sand across the river. It was loaded by shoveling into 5-gal. kerosene-oil tins, carrying the loaded tin upon the shoulder to the banca, and emptying it. Upon arrival at the wall the process was reversed, the material shoveled again into the 5-gal. tin which was carried up a plank from the banca to the wall upon the boatman's shoulder and the tin emptied into the backfill. There were at times 20 or more boats engaged in this traffic, and from 1000 to 3000 cu.yd. per month were placed. Every boat employed was first measured by loading it gunwale even full with sand to its capacity, and marking the inside of the banca with paint where the ends of the pile sloped off, and a number was painted on the boat to identify it. The load was then emptied into a bottomless square box on the ground for measurement.

This first measurement was usually a serious affair, not only the owner of the boat being present, but often his family and friends, and as a matter of course all the unemployed in sight. A native boy was given a list which showed the capacity of each boat corresponding to its number, and he checked all material into place, giving the banquero, or boatman, a receipt showing the amount of material furnished, which he cashed in at the office whenever he desired. This giving of a receipt for something delivered is unto a law in the Orient, and every native wants a "paper" to prove that he has accomplished his errand, whatever it is. Thus when the office boy is sent with a note, the recipient invariably initials the envelope, which the boy returns to the sender. The principle is worthy of emulation anywhere, and is certainly to be encouraged in the messenger. A case is known where an Igorrotte carries with him a certificate, which he is proud to exhibit, which shows that he has been in jail for some petty offense.

Wheelbarrows are of little use in the Orient, as the people are not strong in the arms, but they will carry loads on the shoulders, or on top of the head, which requires two or three men to lift. Engineers are familiar with the story of the Chinamen who loaded the wheelbarrow with earth, and then three men raised it to their shoulders to carry it away.

Filipinos are most efficient when working by contract, or piece work, and in all cases possible this method was used. For example, sand was screened at 7½c. per cu. yd.; the backfill mentioned above was placed at a cost of 17½c. per cu.yd., piles were trimmed ready for rings and driving at 25c. each; piles were sawed off under water by a diver at 50c. each, the government supplying the tender and pumpers and of course all the equipment. A diver, unless he goes into very deep water, wears only the helmet weighted with a piece of chain, and needs no other weights. He does not bother with the air-escape valve, as the air escapes between the collar of the helmet and the body, and if the air hose or life line get tangled up he simply slips out of the helmet and comes to the surface, and this is his usual method of coming out at all times. Work around the water is greatly simplified in the tropics where the men are as much at home in the water as they are on land.

It is to be expected that labor is not as efficient among a people who are not as robust as whites, and who are in most cases slower of movement. There are exceptions, as in the case of the pile-driver engineer, who could operate the hammer equally well with a white runner, and a good native diver will compare favorably with an American. In machine shops and sawmills they learn to operate machines as rapidly. As captains and engineers of launches and tug boats they do an equal amount of work to a white, although when an emergency arises that calls for quick action they are inclined to go to pieces.

A Filipino probably does not work for the love of labor any more than any other human being, nor does he labor with the idea of advancing himself in his work or for promotion, or to accumulate money to take care of himself in the future. In many cases a good laborer has been ruined by advancing his pay or giving him a job as a petty foreman, and the same is true of other races. The native Filipino of the laboring class can live on a few cents a day, or off of a very small piece of land, but he is gregarious and wants to be where his fellows are, and where there is excitement. The water front especially attracts him, as he by nature loves the water, and there he finds diversions in plenty for his amusement with the coming and going of water traffic. He works because he likes the money to buy luxuries like shoes, collar and tie for himself, attractive multi-colored gowns for his wife, and little "Americana" dresses, hats and ribbons for his baby girls. He wants money to spend on "fiesta" days and Sundays at the cock-pit, although in a few years he will be rooting at a baseball game, and the cock-pit will know him not. He cheerfully returns to work on Monday with the previous week's pay spent.

He is a faithful worker under competent supervision. He resents harshness, but he appreciates discipline, fair treatment and justice. He does not expect his white superiors to be on too familiar terms with him, but when his superiors are sympathetic to his troubles he goes to him for advice, for aid financially to get a relative, perhaps his wife, out of jail when caught gambling, for aid in sickness, or perhaps to assist him from the clutch of a greedy money lender. The wise employer soon finds himself in a position of god-father not only to his employees but to their families as well, and such an employer will have a loyal and efficient organization which will remain with him indefinitely.

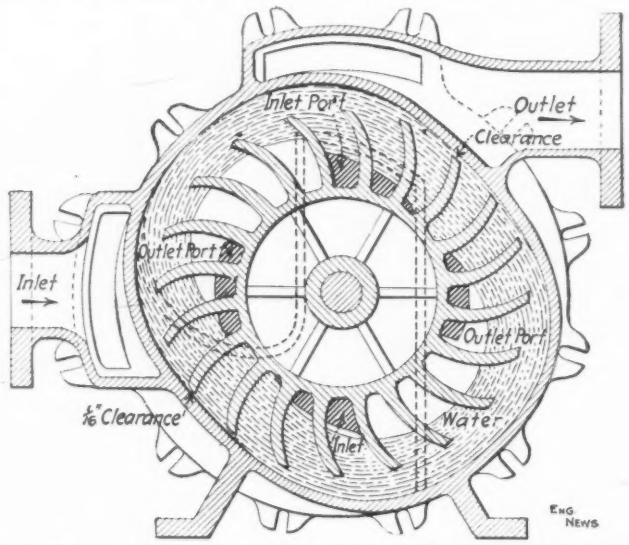
Personnel

This work at Iloilo, as well as all harbor work and the light-house work in the Philippines, is under the Bureau of Navigation, of which Frank P. Helm has been the

Director for several years. H. C. DeLano, now with the Civil Government of Porto Rico, was Chief of the Division of Port Works and Light-House Construction in immediate charge of such work, and was succeeded in 1910 by K. S. Heck, formerly in local charge at Iloilo, who designed the reinforced-concrete wharf described above. The writer was in local charge at Iloilo during the completion of the retaining wall, and at the beginning of the reinforced-concrete wharf, and was later Principal Assistant Engineer of the Division. The work was completed by Harry A. Thompson as Assistant Engineer in local charge, and William Kirk was general foreman upon the work from 1909 until its completion in 1912.

A New Design for Low-Service Rotary Vacuum and Air-Compressor Pumps*

A new type of pump for creating a vacuum or for compressing air has recently been developed and is now upon the market. Its principle of operation is similar to that of certain high-vacuum pumps which have been



CROSS-SECTION OF THE NASH LOW-SERVICE AIR PUMP

described from time to time in ENGINEERING NEWS, but is of much rougher and cheaper construction. It is of simple design, as is shown by the cross-section here reproduced. A circular impeller consisting of a rotor cast with projecting blades causes water to revolve in an oval casing and to follow the casing due to centrifugal force. The water alternately recedes from and surges back into the impeller.

In the sides of the pump casing, where the water leaves the impeller, ports connect to an inlet pipe; outlet ports connected to an outlet pipe are cut in the side of the casing, where the water reënters the impeller. The receding water is replaced by air drawn in by the inlet ports. As the impeller advances, this air, which is contained between the sides of the casing and the rotor, is compressed by the reëntering water and forced out by way of the outlet ports.

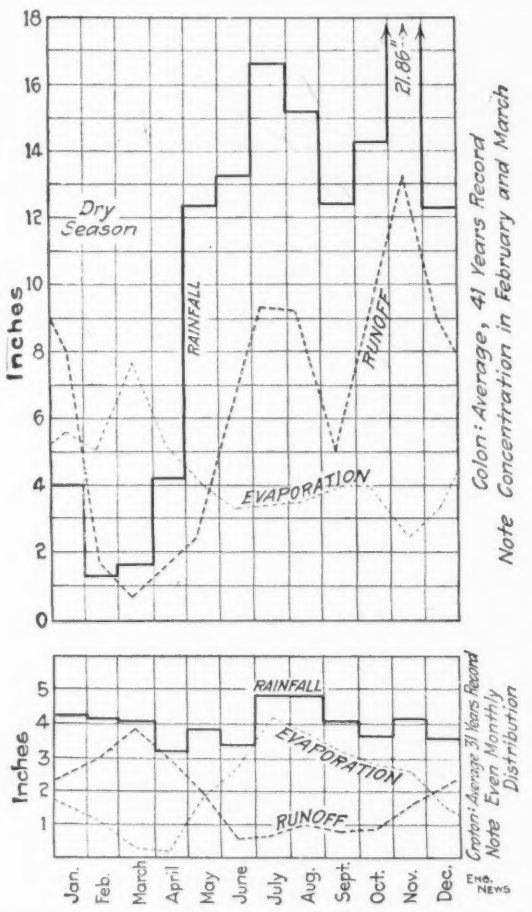
The single-stage pump is now perfected and is adapted to work requiring vacuums of not higher than 20 in., or for pressures not exceeding 15 lb. per sq.in. Where pressures of from 15 to 30 lb. are necessary, e.g., in medium-pressure caisson work, two pumps can be arranged in tandem, the outlet of one pump delivering to the inlet of the other; thus making air available from the first at pressures up to 15 lb. and from the second at 15 to 30 lb. Priming centrifugal pumps is another application for the new pump, which quickly draws the air from the suction pipe of the centrifugal pump, while a flood of water coming over into the vacuum pump at the end of the priming operation, has no detrimental effect.

The Nash Engineering Co., of South Norwalk, Conn., manufactures at the present time, six sizes of these pumps. For vacuum work their capacities range from 30 to 450 cu.ft. of air per min., with corresponding speeds of 1150 to 430 r.p.m. As air compressors, they handle from 30 to 500 cu.ft. of free air per min., at speeds of 1400 to 500 r.p.m.

*Matter on air pumps for high duty was published in the following issues of "Eng. News": Aug. 19, 1909; Nov. 7, 1912, and Sept. 11, 1913.

Comparison of Panama and Croton Rainfall, Runoff and Evaporation Data

We reproduce on this page, with corrections, a diagram which appeared in our issue of Oct. 2, 1913, comparing rainfall, runoff and evaporation for long periods at Colon, Panama, and in the Croton drainage area, New York City. The Colon data represent conditions at the Atlantic end of the Isthmus in the vicinity of the Brazoo Brook reservoir. In the diagram published in the issue named the lettering which denoted the runoff and evap-



COMPARISON OF RAINFALL, RUNOFF AND EVAPORATION AT COLON, PANAMA, AND ON THE CROTON WATERSHED, NEW YORK

(Reprinted with corrections from p. 651 of "Engineering News" of Oct. 2, 1913.)

tion were transposed. The diagram appeared in an article on Panama Water-Supplies, by Arthur T. Nabstedt and the transposition was due to an error in the reproduction of the diagram submitted by Mr. Nabstedt.

A System for Storing and Handling Inflammable Liquids

The storing and handling of volatile, highly inflammable liquids, e.g., gasoline, naphtha, ether, alcohol, etc., by the Martini & Hüneke safety system, has been known to Europe for the past eight years. This system is claimed to prevent ignition of the liquid in the storage tanks and also its escape in case of a break or leak in the distributing pipes.

Throughout the apparatus in which the liquid is stored or handled, air is replaced by an inert gas, e.g., carbon dioxide. The gas serves as a protective agent and its pressure determines the movement of the liquid. All the pipes and valves are jacketed and the space thus formed is filled with the gas so that circulation of the liquid can occur only when the system is absolutely free from leaks. If a leak occurs in the inner shell the pressure is equalized, while if the outer is ruptured the pressure drops to that of the atmosphere. In either case the liquid in the distributing system returns to the storage tank by gravity. This is evident from the fact that the circulation is dependent upon the gas pressure, which would disappear in the event of a leak. Hence, under such circumstances, the liquid will remain in the reservoir, where there is no danger of explosion. The method of jacketing the pipe is shown in Fig. 1.

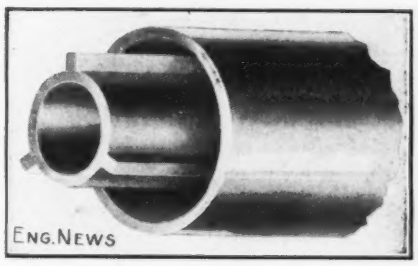


FIG. 1. JACKETED PIPE.
(In operation the jacket is filled with an inert gas.)

The general principle of the apparatus is shown in Fig. 2. A heavy sheet-metal storage tank is buried in the ground, inlet and outlet valves are provided as is also a cylinder of compressed gas for protecting the liquid and forcing it through the piping system.

In the operation of charging, the storage tank is first filled with inert gas, then conveyed to the drum of inflammable liquid, and the latter siphoned through a valve into the tank. Another valve allows gas from the storage tank to replace the liquid in the drum as the latter runs out. To draw the liquid from the storage tank the lever of the discharge valve is pressed; the liquid immediately rises through the jacketed pipe owing to the inert gas pressure in the storage tank.

Explosions sometimes result from the small quantity of liquid left on the walls of the drum volatilizing and combining with air. The filling of the drum with a non-combustible gas prevents such an accident. As a further protection, an anti-diffuser (Fig. 3), operating on the principle of the Davy safety lamp as used in mining, is attached to the end of each pipe which enters the storage tank. The upper part is filled with wire gauze which admits the passage of either a liquid or a gas, but not of a flame.

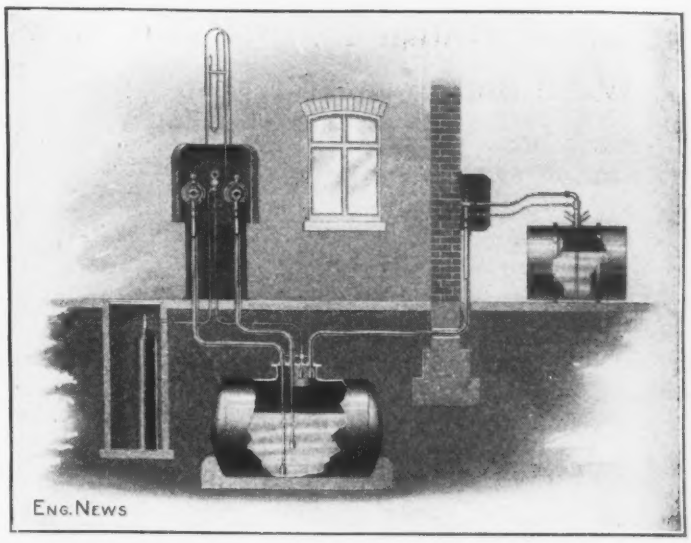


FIG. 2. A TYPICAL INSTALLATION FOR STORING AND HANDLING INFLAMMABLE LIQUIDS BY THE MARTINI-HUENEKE SYSTEM

For small installations carbon dioxide gas is commonly used. This is readily obtainable, in cylinders containing from 20 to 50 lb. each. For large plants a special generator is provided which produces gas at the minimum cost.

This system is about to be produced in the United States, a company having been formed for that purpose.

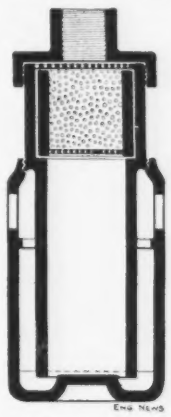


FIG. 3. THE ANTI-DIFFUSER

The extent to which this system is believed in abroad may be appreciated from an extract from the Revised Police Fire Ordinances of Berlin, Germany, Nov. 15, 1909, Sec. 4: "Benzine is to be stored and distributed by the Martini & Hueneke system, other systems being allowed only if it can be shown that they afford the same protection."

The "Imperator" is equipped with this system as are more than 40 ships in the German navy. An idea of the diversity of application of this method may be had from the following classified list of installations in Germany: hangars for aircraft, 12; mining, 121; garages, 262; wholesale drug houses, 11; rubber, varnish and oil-cloth factories, 39; municipal plants, 34. In all, there are over 3000 installations of this system in Europe.

Uniform Test Bars for Cast Iron—"Some time ago the Foundrymen's Association, working conjointly with the American Society for Testing Materials, adopted a set of specifications for Cast Iron and Iron Castings. You are all doubtless familiar with the 'Arbitration Bar,' so called, which forms the basis of this set of specifications. The adoption of this bar (1¼ in. round, cast on end in dry sand, and tested transversely on supports 12 in. apart) in this country has been very slow, owing to the prevalence of other bars in foundries, the information gained from which it is not desired to throw away. Nevertheless this 1¼-in. diameter bar —though in different lengths—has now been adopted by most of the cast-iron producing nations of the world. If there are any serious objections to its use here, these should be thrashed out and settled; but this or some other acceptable bar should appear in at least a majority of all the specifications used for gray-iron castings. I would urge the members of this association to bring this bar into their specifications wherever possible, so that a good start toward uniform specifications may be made."—R. S. McPherran, Milwaukee, Wis., in a paper before the American Foundrymen's Association, Oct. 15, 1913.

Report of British Experts on a New Water-Supply for Ottawa, Ont.

A gravity water-supply for Ottawa, Ont., at an estimated cost of $7,985,000, has been recommended by Sir Alexander Binnie, consulting engineer, of London, England, and formerly chief engineer of the London County Council, and the recommendation has been indorsed as to quality by Dr. A. C. Houston, chemist and water examiner of the Metropolitan Water Board of London.

The supply as proposed would be brought from the Gatineau Lakes through some 44 miles of 54-in. welded steel pipe to a 354,000,000 U. S. gal. service reservoir at Chelsea, from which two 51-in. steel supply mains, each about six miles long, would lead into the city. A dam at one of the lakes would raise the level of three of the lakes to elev. 570 ft. above datum, which would mean an increase in depth of 40 ft. in the largest lake in the series. A tunnel from one of these lakes to a fourth one would direct the waters of the three lakes from the north to the south and into the fourth lake, raising its level to 570 ft. also. The service reservoir would have a normal water level of 445 ft. above datum, which would give a static pressure of 118 lb. at the present pumping station in the city and of 81 lb. on Parliament Hill. The water is considered to be of so high a quality as never to need filtration, provided proper steps are taken to prevent human pollution—the present population being 135 on 150 sq.mi. of drainage area. The water is also described by Dr. Houston as very soft and remarkably colorless and generally very clear.

Aside from the fact that Ottawa went to England for advice, particular interest attaches to the report just outlined because of the two water-borne epidemics of typhoid fever at Ottawa* attributed to leaks in the pipes leading from the Ottawa River intake to the pumping station and also because of the rejection by popular vote of two successive plans for a new water supply recommended by Allen Hazen.†

The people of Toronto having voted down two water-supply plans proposed by an American engineer and indorsed, as we understand, by their city officials, sent to England for advisers. In February, 1913, Messrs. Binnie and Houston arrived, and on the tenth of the same month they handed in a report (said to have been written on a single sheet of foolscap, and to have "cost a pretty penny") advising that the Ottawa River be abandoned for a supply from a series of lakes 40 to 50 miles north of Ottawa, lying between the Gatineau and Lievre Rivers.

Surveys were necessary before anything more than a guess at the nature of the new supply works could be made. Arrangements were effected for having these made by the Dominion government, under the direction of "Mr. Legg," sent from England on April 18, 1913, by Mr. Binnie. Mr. Legg spent six months on the work. Mr. Binnie was to have returned to Ottawa, but the amputation of a leg in July made this impossible, so in his place his son, W. J. E. Binnie, accompanied by W. R. Tickell (both described by the elder Binnie as water-works engineers of great experience) arrived in Ottawa on Aug. 29. From the information gathered and sent to London by these engineers, it appears that the elder Binnie prepared his report—abstracted at length in the Ottawa *Free Press* of Oct. 8, 1913, accompanied by a message to the city council from J. A. Ellis, Mayor, recommending the adoption of the Binnie plan.

Naturally enough, Mr. Binnie thinks Ottawa's water consumption of 210 U. S. gal. per capita per day (allowing 6½% pump slippage) is excessive. He states that this is six times the consumption of London, and that in his opinion not more than some 75 U. S. gal. per day is actually used, the remainder being "wasted by leaky pipes and house fittings." He bases his supply estimates on 120 U. S. gal. per capita per day, and urges the city to "use every effort to bring down the consumption to a reasonable figure," so a supply of 25,000,000 Imp. gal. a day (30,000,000 U. S. gal.) will supply 250,000 people, and thus postpone the time when it will be necessary to augment the supply. At the same time, writing from an experience over 50 years, he realizes the difficulty of curtailing waste in the case of a new gravity supply.

The main sources of the proposed new supply are Thirty-One Mile and Pemichangaw lakes, with a drainage area of about 150 sq.mi. There are no rain gages in this drainage area, and for the two gages 25 miles south, Mr. Binnie was able to get the records of only one, and that was not established until May, 1911. Without going into details regarding the meager rainfall data available and the even more scanty runoff data for adjacent territory, only, it may be said that Mr. Binnie's estimate of the yield from his proposed source of supply is based on a runoff of 13.5 in. for the three driest consecutive years, which would give 81,000,000 Imp. gal., or about 97,000,000 U. S. gal. per day, "ample to meet the requirements of 750,000 people."

Besides the two lakes named, there are two small ones essential to this scheme, Mitchell at the north of the chain of four lakes, and Long at the south. Mitchell is the lowest of the four, and through it water from the two large intermediate lakes flows northward. Long Lake is the highest of the four, its waters flow southward, and it is the head of the proposed aqueduct. Beginning at the north, Mitchell Lake has an area of 0.7 sq.mi., and its water surface in September, 1913, was at elev. 523 ft. above datum; next on the south comes Thirty-One Mile Lake, with a length of 18 mi. and a water surface of 18 sq.mi., at elev. 530; still farther south is Lake Pemichangaw, with a length of some 5 mi. and a water surface of 6 sq.mi. at elev. 552 during the past summer; at the extreme south is Long Lake, some 1¼ mi. in length, only 0.25 sq.mi. in area, at elev. 561 ft. In the language of the report:

> It is proposed to tunnel through the ridge between Pemichangaw and Long Lake, and by means of a dam at the outlet of Mitchell Lake to bring the lakes all to one level, namely 570 ft. above datum, and to start the aqueduct to Ottawa from the south end of Long Lake. This would mean raising Mitchell Lake 47 ft., Thirty-One Mile Lake, 40 ft. and Pemichangaw Lake, 18 ft.

*See "Eng. News," Mar. 23, 1911, for special report to this journal on the 1911 outbreak and Aug. 8 (p. 273) and Oct. 24 (p. 792), 1912, for notes on the 1912 outbreak.

†See "Eng. News," Nov. 10, 1910 (p. 521) for note on report made by Allen Hazen on the cost and relative merits of an untreated gravity supply from Lake McGregor, and a filtered and pumped supply from the Ottawa River. Evidently Mr. Hazen favored the gravity supply. In "Eng. News" of Dec. 7, 1911 (p. 693), there was briefly noted a report by Mr. Hazen, Chas. H. Keefer, Dr. Charles Hodgetts, of the Canadian Conservation Commission, and John W. M. McCullough, Provincial Health Officer of Ontario. All but Mr. Keefer joined in recommending the McGregor Lake supply. In our issue of Aug. 21, 1913, we commented editorially on water-supply happenings at Ottawa under the heading "On Self-Appointed and Popularly-Elected Municipal Experts."

The level of Long Lake would be raised, we understand, by damming it from Lake Pemichangaw through the proposed tunnel.

At the 570-ft. level it is assumed, in the absence of complete surveys, that the four lakes will have a total area of 75 sq.mi. On this basis, 1 ft. of water depth would give 6,100,000,000 Imp. gal. of storage and 4½ ft. depth would give water enough for 75,000,000 Imp. gal. a day for one year.

A narrow, rocky gorge at the outlet of Lake Mitchell affords "an admirable site for a dam," which would require only 9100 cu.yd. of masonry.

Because of its large area it would take five or six years for Thirty-One Mile Lake to fill to the level of Pemichangaw, and 10 to 12 years for it to reach its final proposed level. On this account, Lake Pemichangaw alone would be available as a water supply for some years to come. Accordingly, the leaky wooden dam across the short stream connecting this lake with Thirty-One Mile Lake would be replaced with a water-tight dam. Pemichangaw and Long lakes together have a drainage area of about 41½sq.mi., which with 13½ in. runoff would yield 22,500,000 Imp. gal. a day, a quantity which would be ample for many years. This, however, will be below the proposed capacity of the first supply main, which is 25,000,000 Imp. gal. per day. On this account the estimates include the cost of the dam at the outlet to Mitchell Lake, and it is urged that this dam be built at once, so as to provide for filling Thirty-One Mile Lake to the level of Lake Pemichangaw, thus giving the full 81,000,000 Imp. gal. per day storage capacity as soon as possible—or, theoretically, 10 or 12 years hence.

The tunnel to conduct water from Lake Pemichangaw into Long Lake, through the height of land separating the two drainage areas, would be 3000 ft. long and "about 7 ft. internal diameter, so as to permit of the whole available yield, namely, 81,000,000 Imp. gal. per day, being passed through into Long Lake without appreciable loss of head." The proposed level for the tunnel invert is at elev. 546, or 6 ft. below the present level of Pemichangaw Lake and 24 ft. below its proposed 570-ft. level. Fortunately, Long Lake is shallow at its north end, while just beyond its south end its outlet falls some 50 or 60 ft. in a short distance. By means of a "short cutting" through the barrier at the south end, Long Lake can be drawn down 20 or 30 ft., thus enabling the tunnel between Long and Pemichangaw lakes to be readily drained during construction.

The proposed outlet works from Long Lake to the aqueduct would include a "straining tower" about 50 ft. high, in which there would be copper gauze screens. High-pressure water to wash the screens would be supplied by a pump driven by a turbine located at the foot of the rapids in the outlet of the lake.

The 54-in. welded steel pipe line would be 235,000 ft. or some 44 miles in length, made from $\frac{7}{16}$-in. plates. For the protection of the outer surface of the conduit in swampy ground, the estimates include an allowance for surrounding the pipe with "tarred hessian or jute." The estimates all provide for laying the pipe with its bottom 8 to 9 ft. below the ground surface, as a precaution against freezing.

The 295,000,000 Imp. gal. service reservoir near the city would provide 12 days' storage; would have an area of 54 acres; would have "a flat bottom surrounded by hills"; and would have its bottom stripped.

The two 51-in. supply mains from the service reservoir to the city are calculated to supply (1) a maximum per capita consumption of 150 Imp. gal. per day (allowing 40 gal. for "unavoidable waste") and (2) 25 fire streams equivalent to 36 Imp. gal. per capita per day.

For crossing the Ottawa River and the tail-race canal from the present pumping station, Mr. Binnie proposes to support the two 51-in. mains on one suspension bridge of 500 ft. span, and on another of 300 ft. span and on box girders of 80 ft. and of 120 ft. span. He strongly advocates bridges rather than laying the pipes on the river bottom, because on the river bottom they could be inspected and maintained only with difficulty. A tunnel beneath the river was considered, and was given up because of probable leakage into it through seams in the rock. Suspension bridges were selected for the long spans because they "can be made light and elegant in design at a smaller cost than any other form of bridges for these spans."

The estimated cost of the works outlined is summarized in the report as follows:

HEAD WORKS	
Dam at outlet of Mitchell's Lake to raise water surface to 570 ft.	$130,180
Clearing and burning area to be submerged	128,000
Tunnel between Pemichangaw and Long Lake, including shafts, etc., —3000 lin.ft.	119,630
Outlet works at Long Lake—straining tower, etc.	43,660
Smaller works about lakes, including subsidiary dams at depressions in height of land, temporary works at Pemichangaw, dowering and clearing Long Lake, etc.	72,000
AQUEDUCT TO SERVICE RESERVOIR	
54-in. steel main, $\frac{7}{16}$ in. thick between outlet tower and service reservoir—235,000 lin.ft.	4,314,080
Bridge on Gatineau River	30,000
Various smaller stream crossings and culverts	110,000
SERVICE RESERVOIR	
Dams	212,150
Clearing and stripping site	21,460
Inlet and outlet works	26,600
AQUEDUCT SERVICE RESERVOIR TO CITY	
51-in. steel main, $\frac{7}{16}$ in. thick between service reservoir and city—two lines of pipe each 32,000 lin.ft.	1,101,120
Various smaller stream crossings, culverts, etc.	20,000
Bridge across the Ottawa River	180,000
Total for works	6,508,880
Add 15% for engineering and contingencies	976,320
	7,485,200
Land, lakes compensation and wayleaves	500,000
Total estimate	$7,985,200

Mr. Binnie thinks that three working seasons would be required to lay the pipe and build the various structures. He estimates the annual "working expenses" or maintenance of the finished system at $15,000 a year.

As can be seen, the operating expenses would be insignificant compared with the interest and sinking fund charges. These would be $412,400, making a total yearly charge of $427,400 for a gravity water supply of 81,000,000 Imp. gal., or about 97,000,000 U. S. gal. a day brought as far as the service reservoir, with supply mains from there to the city capable of supplying water at the rate of 46,500,000 Imp. gal. per day, the estimated maximum water consumption—the average for some years being assumed as 25,000,000 Imp. gal. per day.

The heavy burden of $427,400 a year would be relieved, Mayor Ellis states, by a new or additional annual contribution of $85,000 a year from the Dominion Government (Ottawa being the capital city) and by a saving of $80,000 a year pumping expenses. To this there might be added, in making comparison with other water-supply projects, the saving effected on the assumption that filtration would be unnecessary.

The proposed scheme has been adopted by the City Council and will be carried out, provided it receives the approval of the Dominion Government. In adopting the scheme the Council also voted to retain Sir Alexander Binnie at a fee of $400,000, he to furnish his own engineers and inspectors.

Sloughing Off of the Mississippi Levee at Helena, Ark.*

On Aug. 23 a section of what is probably one of the largest levees in the Mississippi Valley, protecting the lower portion of the city of Helena, Ark., broke, and without warning slid transversely some 30 to 60 ft. toward the river. On Sept. 11, 19 days later, a second slough occurred of about equal size, which partially crippled some sawmills on the levee which depended on tramways to the river for their log supply. In the early part of October a cave-in of immense proportions in the adjoining part of the levee made itself apparent. Smaller cave-ins had occurred every week or two in the interval. The accompanying illustrations give some idea of the size and extent of these breaks.

The city of Helena is situated 306 miles below Cairo, Ill., at the foot of the famous Crowley's Ridge, a chain of large hills running north from Helena to St. Louis, Mo. At Helena the river is about ¾ mile from the bluffs. The present levee in front of the city was built by the municipality some 20 years ago and has been maintained and reconstructed from time to time by the city under the advice and general supervision of the engineers of the Mississippi River Commission.

The location of the levee in relation to the city of Helena is shown in the map, Fig. 2. The city is situated on the west bank of the river, some four miles below Trotter's Point, Miss., where the river makes a sharp bend to the west, so that the full force of the current is deflected against the Helena bank in the lower part of the city.

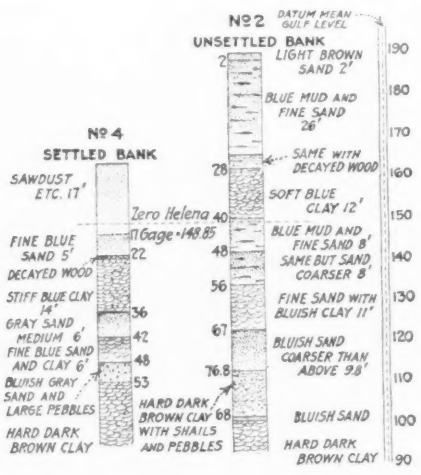


FIG. 1. TYPICAL BORINGS, LEVEE SITE, HELENA, ARK.

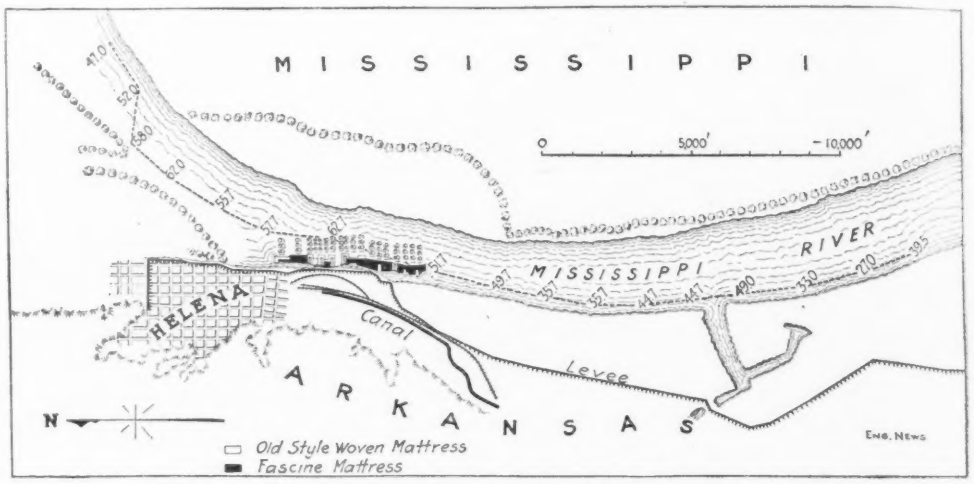


FIG. 2. MAP OF THE MISSISSIPPI RIVER AT HELENA, ARK., SHOWING REVETMENT WORK

At the time of the first slough the river-gage reading at Helena was 4 ft., which is the lowest it had been for several years. The same levee successfully withstood a gage height of 55½ ft. during the flood of last spring.

Sloughing off and caving-in of the banks at this point of the river was an early experience and has received the attention of the government engineers for the past quarter of a century. The bank protection* here consists of 1140 ft. of continuous mattress revetment, with stone paving up to the 23-ft. stage of the river, built in 1889 and 1899; followed on the downstream end by a system of four main submerged spur dikes built in 1889 and inter-

*Photographs and data on recent break from C. V. V. Turner, 221 Miller St., Helena, Ark.

*Mississippi River Report, 1903.

FIG. 3. GENERAL VIEW OF RECENT SLOUGHING OFF OF THE MISSISSIPPI RIVER LEVEE AT HELENA, ARK.

[illegible]ate dikes built in 1898, thus protecting 1180 ft. of [illegible]. The intervals between the dikes, except the lower [illegible] have mattress revetments extending to slightly above [illegible]ow-water stage, but the banks above these revetments [illegible] not protected. Below the dikes is 2580 ft. of continuous revetment built in 1896 and 1898, consisting of [illegible]ine mattresses* and stone paving extending to the [illegible] ft. stage, and in some places to a higher stage. The total length of protection is 4900 ft. This revetment has been repaired from time to time so that at present there is about 3500 ft. of bank protected by continuous revetment and 1400 ft. protected by submerged spur dikes (see Fig. 2).

The levee is close to the top of the river bank along nearly all the revetment. At the dikes it approaches to within 30 ft., and below the dikes the levee is so close to the river that for nearly 1000 ft. the toe of the levee and the top of the river bank practically coincide.

For several years prior to 1901 there was a slight settling of the revetted bank. This increased considerably during low water of that year and the condition of the bank remained about the same after the low stage of 1902. Where the banks were not revetted there was a continuation of pocket cave-ins. Much seepage water was discharged from the bank at these cave-ins. Between dikes 4 and 6, a distance of 1600 ft., there had been almost continual settling, indicated by a persistant crack which extended along the 25-ft. contour. The amount of settling in many cases was fully 5 ft. The character of the settling (prior to 1903), the fact that the bank below low water was undisturbed, and the flow of the seepage water in the cave-ins, indicated that the seepage water was the cause of the trouble.†

Ditches were subsequently dug in the levee to drain off the seepage water. The scheme was to cut into the bank a series of lateral drain ditches and fill them with brush in the bottom and riprap stone above; the ditches to start near low water and have a rather flat grade to the fault line. Work was begun on these in 1903, but the scheme was never fully carried out for want of sufficient appropriations. A drainage canal was also dug in the rear of and parallel to the levee.

In 1903, when low water occurred, more bad slides developed and a further investigation was conducted by the Mississippi Commission engineers, under Capt. E. W. Van C. Lucas, Engineer of the First, Second and Third Districts. The engineer in charge at Helena was W. M. Rees. The slide in December of this year (1903) occurred when the river was at a 3-ft. stage. The settled area covered in its entirety the same in which a similar settling had occurred in October, 1889, before the revetment had been placed, and is practically the same area which has recently failed (1913). The revetment in each instance has not apparently been seriously affected.

After the sloughing off of the levee ten years ago, but a small sum was available for permanent repair work and this was expended to revet two deep pocket cave-ins between dikes 2 and 3 with mattresses from the bank to overlap the channel mattresses, to build up across each pocket a crib dike to reduce eddy action, and to place brush drains in the face of the levee where it was deemed necessary to remove seepage water and prevent further sloughing. A part of the sum available was also expended to make borings along the top of the bank of sufficient depth to determine the character and thickness of the stratifications through which the seepage water came.*

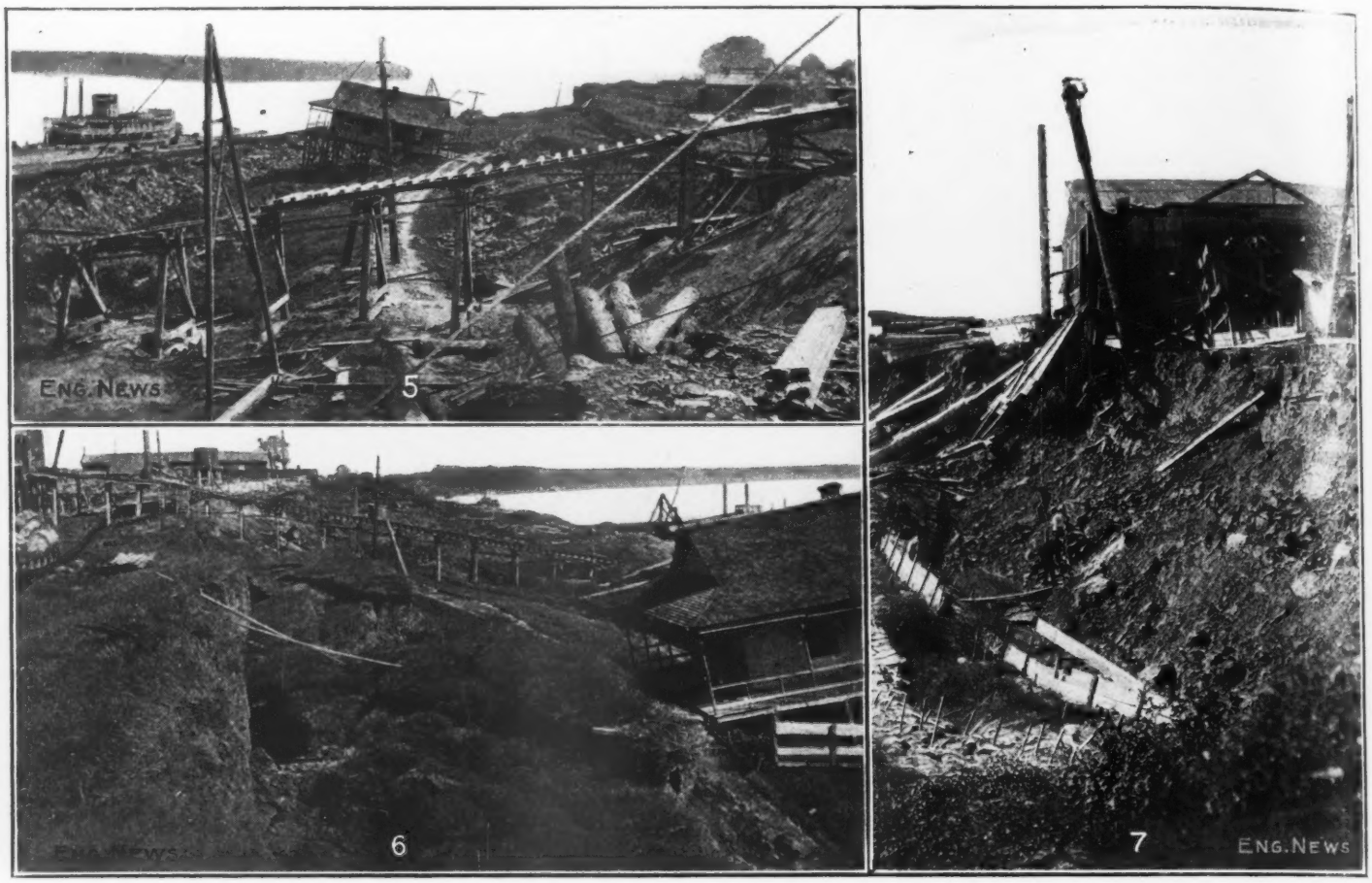
In all, 14 holes were bored, ranging in depth from 50.5 to 121 ft., aggregating 1052 ft. Two typical borings are shown in Fig. 1. Eleven of these bore holes were outside the levee, close to and, in some cases, on the settled bank. Three borings were made inside the levee

*Mississippi River Commission Report, 1904.

FIG. 4. OCTOBER CAVE-IN, MISSISSIPPI RIVER LEVEE, HELENA, ARK., LOOKING NORTH

*For a description of these revetments see "Engineering News," Oct. 31, 1901, p. 322.

†Mississippi River Commission Report, 1903.



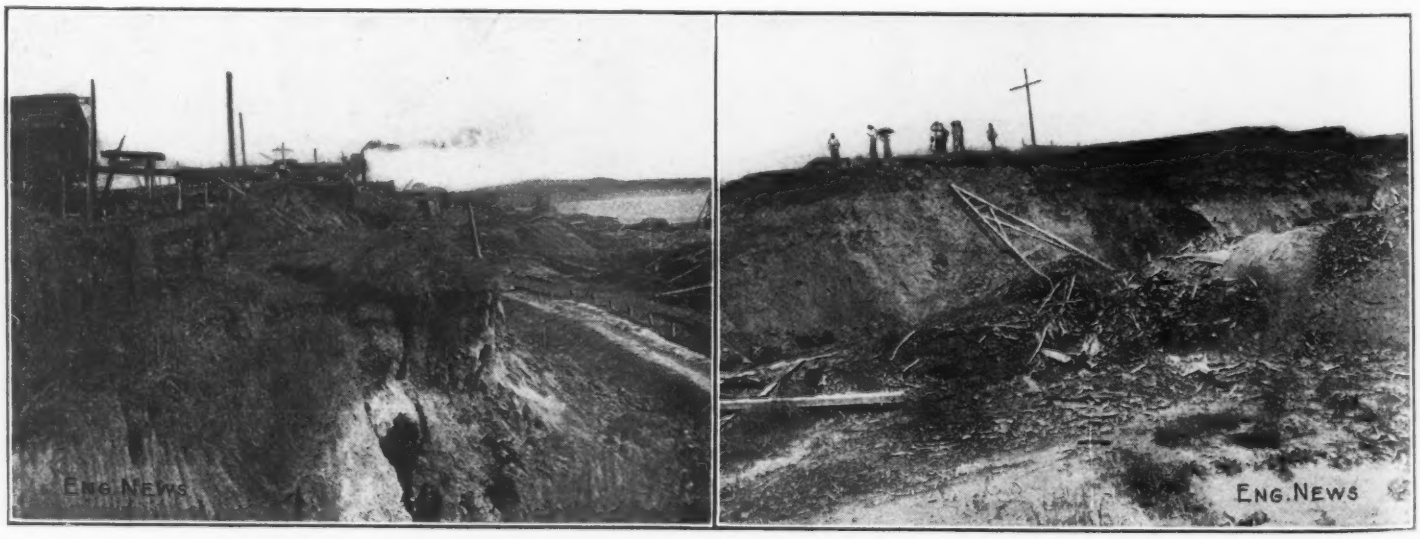
FIGS. 5, 6 AND 7. VIEWS OF SLOUGH IN MISSISSIPPI LEVEE AT HELENA, ARK., WHICH INVOLVED 1,500,000 CU. YD. OF EARTH

and some distance back. They all showed, in general, that the materials above the low-water line are blue muds or clays, mixed more or less with sand, usually somewhat coarser near the bottom, decidedly water bearing, and in some places "quick," and that this rests upon a hard brown clay, practically impervious, with its top from 36 to 39 ft. below the zero stage of the river. One hole bored through this brown clay showed a thickness of over 40 ft.*

Soundings made in the river showed that on the bottom the sand stratum outcrops in the river bed from 150 to 250 ft. from the zero contour, the channel mattresses barely covering it in some places. The conclusion drawn by Engineer Rees at this time (1904) was that any retaining work designed to prevent a sloughing off of the superimposed material would have to be placed far out in the river. At this time Mr. Rees reported that although the revetment had settled in some places it appeared as a whole to be fairly effective; especially was this the case with the fascine mattresses, where no breaks had been caused by high-water attacks. Between the dikes the revetment was never completed to the top of the bank.

There appears to have been no important sloughs after that of 1903 was repaired until five years later, in October, 1908, when an extensive slip occurred taking out

*Mississippi River Commission Report for 1904.



FIGS. 8 AND 9. VIEWS SHOWING THE DEPTH OF BREAK IN LEVEE, HELENA, ARK.

about 500 ft. of levee; but so far as could be ascertained no damage was done the revetment. A small but unimportant fault developed during 1909-1910, but little or no work was done to permanently remedy the defects of the levee.

Such in brief is the history of this particular levee as extracted from the Mississippi River Commission Reports, 1900-1912, inclusive; which shows that while the levee structure has successfully withstood the effect of floods and current, it has almost invariably failed in times of extraordinarily low water.

The present slough shown in Figs. 3 to 9, occurred in practically the same location as the three previous large breaks in 1889, 1903 and 1908. This break has a total length of approximately 1000 ft., portions of which occurred in sections which had not been protected by revetment, and in some cases as much as 300 ft. back from the river bank. A part of the levee which has just failed is an entirely new section built in 1908, 100 ft. in the rear of the section which failed at that time. It is said that at the time of the 1908 cave-in the government engineers suggested a loop levee some distance behind the failed portion, which would have thrown 200 acres or more of the mill property on the river front on the river side of the levee, but that the city was then unwilling to abandon the protection of this property.

The present slough includes the movement of probably over 1,500,000 cu.yd. of earth. It is intended to repair this breach in the levee with fresh earth brought from the hills, until after the coming high water has subsided, when it is proposed to construct a new levee through the mill district, leaving outside of the levee the area in which the present slough has occurred. The contract for the repair work has been let to the Harmon & Thomas Construction Co., of St. Louis, Mo., at a cost of 26c. per cu. yd., which will bring the entire expense close to half a million dollars.

Some General Principles Applicable to Public Construction Contracts

The American Society of Engineering Contractors has a General Committee on Contracts, with W. B. Bamford as chairman, and several subcommittees. The subcommittee on Public Construction Contracts, of which Wm. B. King is chairman and sole member, submitted a brief report some months ago which consisted mostly of a statement of general principles. Through the courtesy of J. R. Wemlinger, secretary of the Society (11 Broadway, New York City), we are enabled to reprint these principles, as follows:

1. Your committee thinks it impossible to submit a complete form to cover all phases of all engineering contracts, but a work of much value can be done by adopting some general principles and formulating them so that they may be made a part of substantially every contract.

2. Every condition of whatsoever character by which the parties are to be bound should be submitted to bidders as a part of the specifications on which they bid. The contract to be signed should be annexed to the specifications. In this way the bidder is not likely to be surprised by new conditions appearing in the contract submitted for his signature after his bid is made and accepted.

3. The greatest vice of contracts is uncertainty. In adopting any form of contract or specifications, every effort should be made to secure exactness of definition of the rights and duties of both parties.

4. Recognizing the impossibility of foreseeing every emergency, some authority must be devised for the determination of either unexpected physical conditions or unforeseen ambiguities in the contract.

5. The first requisite to this is promptness, so that the work may proceed. This doubtless requires that all disputed questions shall be primarily settled by the engineer present on the work.

6. But, while the engineer is the best fitted person to reach a prompt decision, his relation to the owner unfits him for an impartial decision. There must, therefore, be some provision for an appeal to an impartial tribunal, and final settlement of all disputes by it.

7. Disputes should, as far as possible, be settled as the contract progresses, so that the parties can know how they stand. To this end, all matters of dispute should be reduced promptly to writing and all appeals from the engineer's decisions should be promptly taken.

8. Each party should assume full responsibility for his own share of the contract.

9. This involves the assumption by the owner of responsibility for the local conditions and for the borings or other explorations of the site. The contractor should bid on guaranteed local conditions, with an increase or reduction of price for variations from these. The locality belongs to the owner and the contractor should not be obliged to gamble on it.

10. The principle also requires that a contract should not both provide the exact details of construction and guarantee the result. If the contractor is to do the work according to exact plans furnished him by the owner, the owner should take the responsibility for the result. If the contractor guarantees the result, he should be free to adopt his own methods of construction.

11. The contractor, especially when bound by a time limit, should be given the utmost freedom as to the order and manner of doing the prescribed work.

12. Definite provision should be made for the assertion in writing of demands made by either party varying from the normal contract price. The contractor should give prompt notice of a claim for extras and the owner of a claim for a decrease or for the assessment of damages.

13. Some rule should be prescribed for the owner's protection in case of delay on the contractor's part, either by a right to annul the contract, or to take over the work in whole or in part, or to deduct actual or liquidated damages. The subject is one of great difficulty and needs most careful consideration.

14. The contractor should be protected from loss by delay of the owner or the owner's other contractors and provision made for settling such losses, without suit, where possible.

15. What is the proper amount of retained percentages? What should be the maximum part of the contract price to be retained until final payment? Differences of opinion should be adjusted and a uniform rule adopted.

16. Material men insist that the contract bond should provide for payment for materials and labor. This leads to greater security to the material men and consequently lower prices. But it is an unnecessary cost to contractors of established credit. This subject needs the views of both sides.

17. Some contractors and engineers maintain that the contract conditions should be as brief as possible. Your committee believes that all subjects which experience has shown may produce conflict should be definitely disposed of by the provisions fixed in the contract, even if this extends its length.

18. After every effort has been made to avoid all uncertainty in the contract and to settle disputes as they arise, some honest differences of opinion as to the rights of the parties may persist to the end of the contract. The final settlement of uncontested matter should be made without prejudice to the right of the contractor to recover disputed claims in the courts. It has, unfortunately, become too common to declare that on final payment the contractor shall sign a release of all claims arising out of the contract. This is a one-sided and dishonest provision. When payment is earned by a fulfillment of the contract, it ought not to be denied because the contractor believes that he is entitled to more, nor should he be forced by necessity to waive access to the courts to correct wrongs done him in the course of the contract.

An Acid-Proof Mine Pump is about to be placed upon the market by its inventor, George Robinson, of Murray, Ohio. According to "Coal Age," of Oct. 18, practically the only metal exposed to the mine water is the plunger; the cylinders, valve chests and valves are made of wood. Wherever the wood is subject to pressure it is given outside reinforcement. To prevent the valves from spliting, heavy bands of cast iron, which are not allowed to touch the valve seats, are placed around the edges. This pump, which is claimed to have been in operation for 28 months in an Ohio coal mine, with repairs amounting to 85c., has a capacity of 250 gal. per minute, to work against a 600-ft. head.

New Pontoon Bridge over the Golden Horn at Constantinople

By F. C. Coleman*

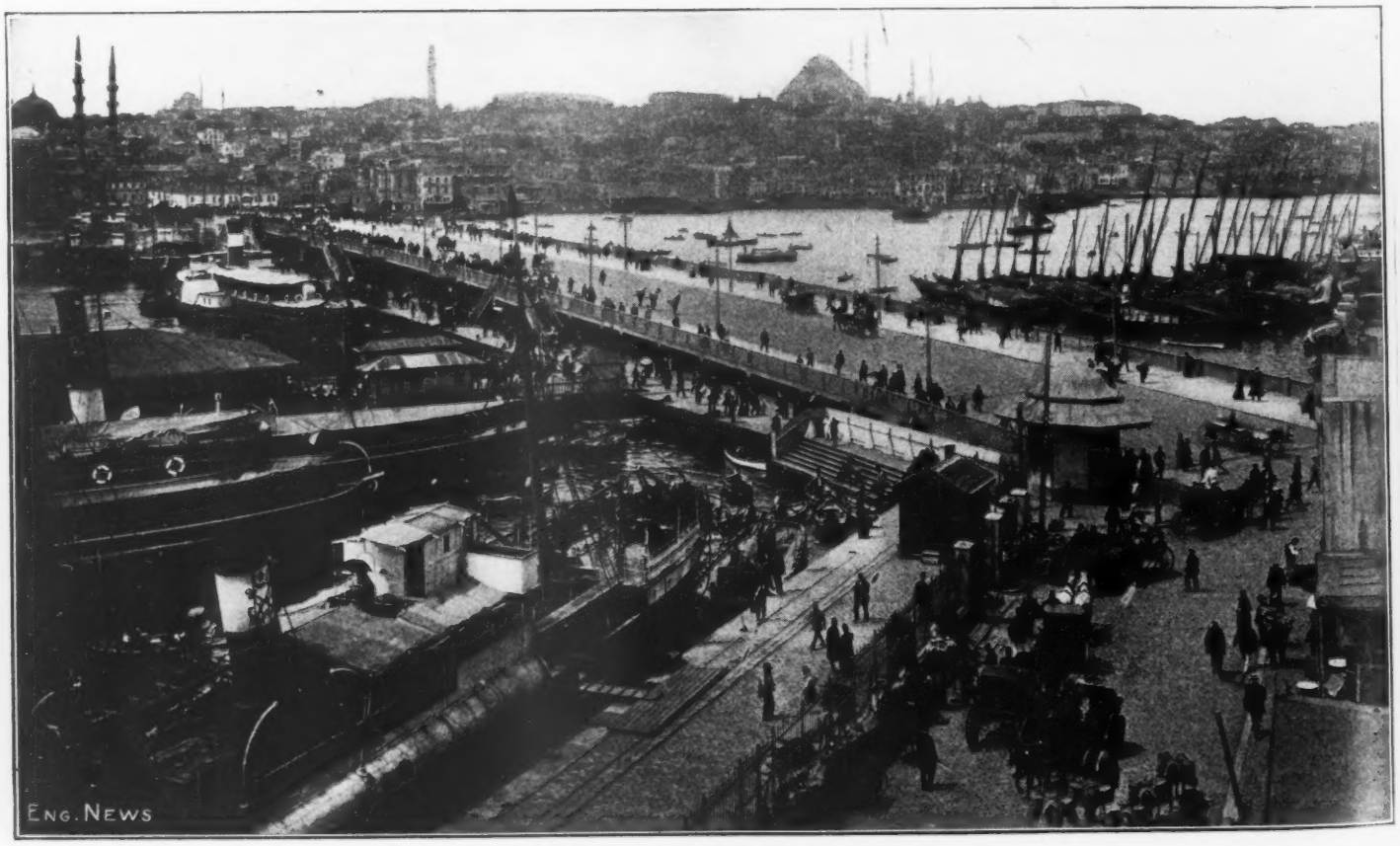
A new pontoon bridge was built across the Golden Horn at Constantinople last year. The structure is of special interest as indicating how a difficult traffic problem which is vital to the business interest of the Turkish capital has been solved. The structure (see Figs. 1 and 2) replaces an earlier pontoon bridge on the same site built about forty years ago; the latter in turn must have replaced numerous prior wooden structures.

*Central Station Hotel, Newcastle, England.

At the site of the new bridge (Fig. 5), the Golden Horn is about 1500 ft. wide. The river banks near-by serve a very large railway and shipping trade. The terminal of the Oriental Ry. is at no great distance from the Stambul end of the bridge. About half a mile up the Golden Horn there is another bridge, but this is little used on account of its unfavorable approaches, so that almost the whole of the considerable cross-river traffic is tributary to the new bridge.

When the scheme of renewing the pontoon bridge was under consideration the imagination of the public of Constantinople knew no bounds. The Eastern mind had formed its own conception as to what the new bridge should be: a single-span bridge built sufficiently high to accommodate ship traffic, and provided with elevators, moving platforms, etc. Various other equally impossible schemes were proposed, the money question generally being left out of account. However, the technical advisors of the Turkish Government planned the matter more sanely, and finally determined upon a pontoon bridge as meeting the requirements in the best and most economical way.

The river bank being low, it was desirable to keep the grade on the structure as flat as possible, and this was one of the controlling considerations in selecting the design. There was also need of providing wharfage for a multitude of small passenger boats. The old plan of mooring boats directly to the bridge and using the bridge as a landing stage could be retained by making the new



Figs. 1 and 2. Old and New Golden Horn Bridges

bridge a pontoon structure. The old bridge had not proved to be any serious obstruction to river traffic between the inner and outer harbor, and therefore it was not considered advisable to incur any great extra expense to facilitate river traffic by constructing a bridge of different type.

Other conditions supported these arguments for the pontoon structure as against other types of bridge. The difficulty and expense of constructing piers or tunnels may be judged from the fact that the depth of water is approximately 120 ft., and that the subsoil is silt on both banks to considerable depth. There is practically no tide, the maximum change in water level being 1 ft. and this chiefly due to the wind in the Sea of Marmora.

The drawing, Fig. 6, herewith, gives a plan of the new structure. In the flanking portions of the bridge the pontoons are generally placed longitudinally, one on either edge of the structure, and carry trusses spanning transversely of the bridge, on which the floor rests. The movable or draw section of the bridge has transverse pontoons which leave two boatways. A view of the framing under the draw section is given in Fig. 4.

The bridge is 82 ft. wide between railings, comprising a 46-ft. roadway and two 18-ft. footways. Its length between abutments is 1530 ft. The draw has a length of 205 ft., but when it is closed there are two navigation openings between its pontoons, each 39 ft. wide, with 17½ ft. clearance height. The longitudinal profile of the floor is parabolic, and its maximum gradient, at the end, is about 4%. The flooring of the bridge rests on steel troughing carried on stringers between the transverse truss floorbeams.

To fix the vertical relation of the successive sections of the bridge adjacent units are connected by horizontal hinges near the floor level. Transverse movements are prevented by mortise-and-tenon sections on the adjoining ends of the section.

The swing span can move through an angle of 180° on the upstream side. It is hinged on the Galata end. At the Stambul, or free end of the span, there are propellers fore and aft, operated electrically. There are locking bolts to hold the moving span firmly in place in its closed position. Both the locks and the propeller motors are controlled from an operator's stand at the bridge

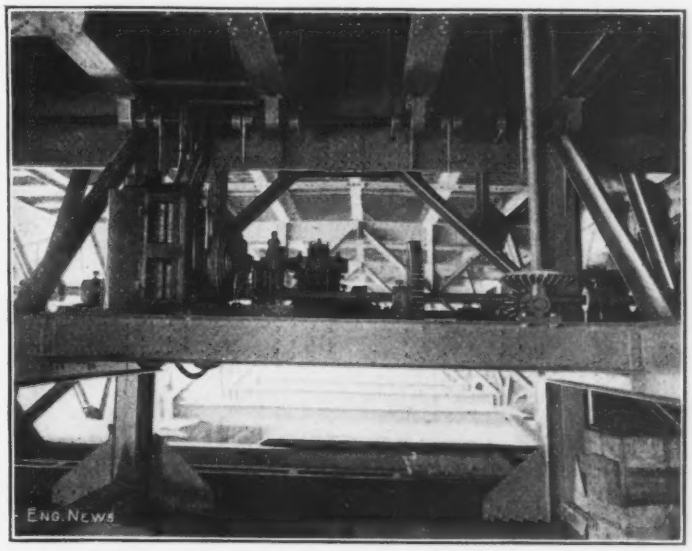


FIG. 4. FRAMING AND LOCK MACHINERY UNDER DRAW SECTION OF GOLDEN HORN PONTOON BRIDGE

railing. Connected with the locking mechanism is the actuating mechanism of the hinged apron-plates which cover over the narrow openings between fixed and moving portions. The lock mechanism may also be operated by hand in case of failure of the electrical mechanism. In such circumstances the moving span would be swung by a tug.

The abutments carry practically nothing but their own weight and the small roadway live-load which pertains to them. However, they required pneumatic foundations; further, on account of the unfavorable subsoil, they are provided with anchorages extending a considerable distance into the bank.

Landing platforms extend along the two sides of the bridge at a level well below the bridge roadway and accessible from the latter by stairs. There are seven landing places on the downstream side of the bridge and five on the upstream side.

The bridge was built by the Maschinenfabrik Augsburg-Nürnberg, of Gustavsburg, near Mainz, Germany.

FIG. 3. PONTOON LANDING-STAGE ALONG ONE SIDE OF NEW GOLDEN HORN PONTOON BRIDGE

Work for the construction of the new bridge was begun in the summer of 1910. The new abutments were built without interrupting traffic on the old bridge. The pontoons and other floating work were erected some distance up the Golden Horn. This erection work required about two years for its completion, the structure containing about 8000 tons of steel. In the summer of 1912 the new bridge was placed in position.

Bridging the Bosphorus and the Golden Horn at Constantinople

By H. G. Tyrrell*

The recent completion of a new pontoon bridge over the Golden Horn tends to arouse special interest in the project for crossing the Bosphorus, an undertaking which has been considered for 2500 yr. without satisfactory fulfillment. These straits, separating Europe from Asia,

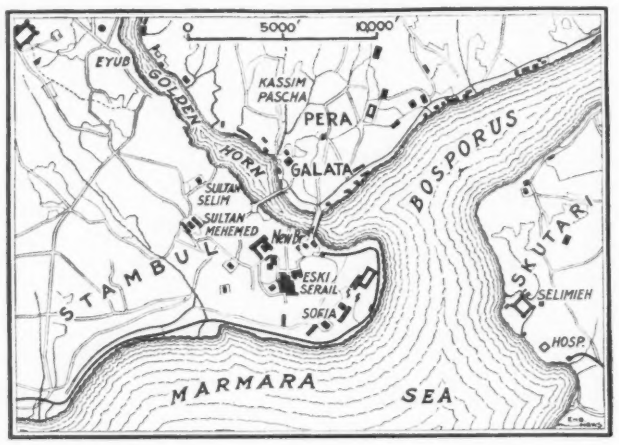


Fig. 5. Sketch Map Showing Location of New Pontoon Bridge over the Golden Horn

have always been a study to the military officials of the adjoining countries, and, while a bridge would no doubt be beneficial for commercial purposes, the disadvantage of communication in time of war has had much to do with the frequent abandonment of meritorious schemes.

Almost every schoolboy knows the familiar story of how Darius Hystaspes, fourth king of the Persians, when preparing in 493 B. C. to invade Thrace, built a bridge of boats across the Bosphorus at a place where it was 3000 ft. wide, for transporting his army of 600,000 soldiers, the work being done under the direction of Mandrocles, of Samos. After the destruction of this historic bridge of boats, the straits has remained for centuries an unbridged channel. The more recent efforts to place a monumental structure there are well within the memory of many now living.

One of the first attempts was made in 1865-1867, when M. von Ruppert and his son Charles made an elaborate design for a high-level bridge over the Bosphorus, which was exhibited at the exposition in Paris. The contour of the channel bottom is known to contain rocky ridges, over which the depth of water is less than in other places, and a site of this kind was chosen, about 10 miles northeast of Constantinople, near Roumelie Kijoi, between the castles of Roumelie-Hissar, in Europe, and Annatoli Hissar, in Asia. At this place the distance across is 2250 ft., and the water ranges from 105 to 130 ft. in depth, the banks on both sides being high and steep. After careful investigations and observations of the bridge at Niagara (completed a few years before), the Ruppert concluded that a suspension bridge was not stiff enough for carrying trains and other heavy loads at a great height above the water, and they, therefore, decided on using some structure of rigid type. Since not more than two piers would be permissible, Carl Von Ruppert considered that an opening of 650 ft. would be too long for a truss span of the ordinary kind, and he, therefore, chose a parabolic form somewhat similar to the bridge at Hassfurt or to Brunel's Saltash bridge. Ruppert's design was very ornate, with massive stone abutments and double cast-iron tubular piers, all of which were surmounted with groups of statuary. His plans showed center piers 670 ft. apart with a 540-ft. span at each side. The whole cost was placed at $2,915,000.

Some years after completing the railroad bridge at Niagara, J. A. Roebling prepared several elaborate designs for the proposed bridge over the Mississippi, at St. Louis, in competition with James B. Eads. Mr. Roebling expressed great delight in the contemplation of Ruppert's Bosphorus design, but still declared that a suspension in a single span was the proper kind of bridge for the location, and he outlined one for the place. But when Mr. Eads' arch design was accepted for St. Louis, he (Mr. Eads) had such assurance of his ability to execute similar arches in much longer spans that in 1877, with the coöperation of A. O. Lambert, he prepared an elaborate design for a bridge to cross the Bosphorus from Pera, just across the Golden Horn from Constantinople, over the channel to Skutari. The plans showed a structure 6000 ft. long (in fifteen spans) and 100 ft. wide, with the deck 120 ft. above water. The middle 750-ft. arch between granite piers 50 ft. thick was flanked by arches 500 ft. long at each side, and succeeding ones of smaller span led out to the shores, terminating in arches 200 ft. long at the ends. The bottom of the channel opposite Constantinople has 15 to 20 ft. of mud and silt

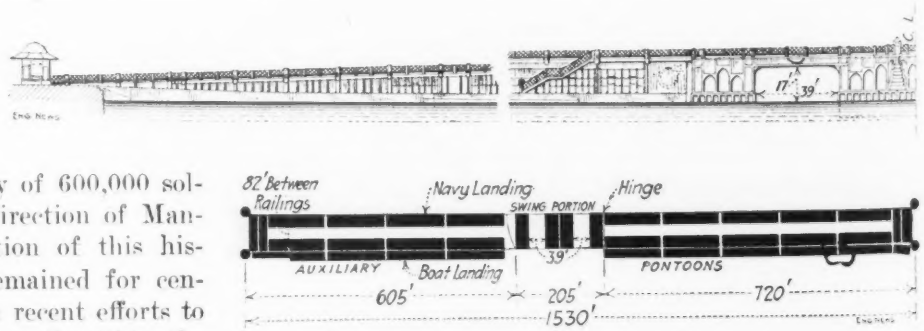


Fig. 6. Sketch Plan and Elevation of New Golden Horn Bridge

over solid rock, and the piers would therefore be 270 ft. high, standing in 100 ft. of water. For the construction of these piers there is plenty of available granite near-by.

The building of the St. Louis bridge occupied 8 yr., but Mr. Eads considered that this one could be finished in 6 yr. and that the cost would not exceed $25,000,000, though it might under favorable conditions be 20% less. He believed also that property values on the other side

*Evanston, Ill.

the straits would be sufficiently enhanced to more than the cost of construction. But the amount of money be raised was so great that work was not undertaken. Twelve years later the problem was attacked by French engineers, who preferred a site 10 mi. north of Pera, near that selected in 1865 by Von Ruppert; the distance across at this new site was 2624 ft. Piers, if used, would stand in 115 to 130 ft. of water; three spans might possibly be cheaper than one, but, nevertheless, the French proposal was for a single span.

The following year (1891) Messrs. Giano and Gourrier presented plans to the Turkish government for crossing from Stambul to Sutari, with a total bridge length of 6500 ft., or 4920 ft. between abutments. These plans showed six openings, crossed 130 ft. above water by cantilevers without intermediate spans, standing on five piers in 105 ft. of water. The trusses were 820 ft. long, with curved upper chords and horizontal bottom chords.

In 1897, another scheme, by a Swiss syndicate, was again presented to the Turkish government.

The project was revived again in 1901, for a high-level suspension bridge 1700 ft. long between towers, to carry a railway from Bagdad to the Persian Gulf over the straits at its narrowest part, about 2000 ft. across, midway between the Black Sea and the Sea of Marmora, near the site where the bridge of boats was built by Mandrocles in 493 B. C. The estimated cost of the suspension was $15,000,000.

In discussing the subject in 1907, one of the leading engineering journals said, "The last bridge was that built by Darius, for the use of his army, long before the Christian era. The plans for the Turkish bridge were accepted years ago, and they call for short suspension spans between a succession of granite towers, of which the foundations are now being built."

Bridges over the Golden Horn

The Golden Horn is a water course leading out from the Bosphorus to the north, and separating Constantinople from the suburbs of Galata, Topana and Pera. Pontoon bridges have long been maintained across this busy channel, one being erected in 1837. The deck of this bridge was 36 ft. wide; most of it was near the water, but in two places were elevated platforms reached by grades, leaving openings at all times for small river craft. It was wholly of timber and was supported on floats, being divided into sections which could be removed for the passage of ships. It was held in place by cables and anchors.

In 1860, an elaborate design for crossing the Golden Horn was made by the celebrated English engineer, Thomas Page. His plans showed a suspension bridge with cables over four central towers in a cluster, the distance between the towers being 80 ft. It was quite similar to Schwedler's design, of 1850, for crossing the Rhine at Cologne, and to Mr. Page's later one of 1869, for Calcutta. In this case the clear height under the cables at the center was 200 ft., leaving plenty of space for very large sailing ships. Each of the two spans was 600 ft. long. His plans contemplated upper and lower roadways 22 ft. apart vertically, the upper one being intended chiefly as a promenade. A headroom of 20 ft. was allowed below the lower floor, that ordinary river boats might pass anywhere. The four octagonal towers, 40 ft. in diameter and with tops 320 ft. above water, stood on piers 125 ft. long and 40 ft. wide. They were in the Moorish style of architecture. The interior of the towers was divided into waiting rooms, observation floors and cafes.

In 1872-75 the old wooden pontoon bridge was replaced by a new one at Karakeni, a contract having been made between the Turkish government and George Wells, a civil engineer, of London. The original contract price for a bridge 1350 ft. long was $475,000, to cross between Azap-capon, but after the contract had been made the government officials changed the location to a place which was 100 ft. longer than the first, and they agreed to pay an additional sum of $30,000. But on receiving the iron from Newcastle, England, it was found to be 9 ft. longer at each end than was provided by the abutments and the grade level was therefore raised by discharging a portion of the ballast from the pontoons. The contractor demanded and secured damages for several months' delay in the amount of $500 per day.

Another bridge over the channel was completed in 1907.

The latest bridge over the Golden Horn, connecting Galata with Stambul, was begun in September, 1910, and completed in the autumn of 1912. It replaces the one built in 1872-75. The other bridge, half a mile further up the channel, has, on account of its position, only light traffic, but over the Galata bridge the travel is very heavy, requiring a roadway 82 ft. wide.

⁂

Repairs to the Imperial Valley Irrigation System on the Mexican side, in and along the Alamo Canal which supplies the irrigating water used by the Imperial Valley, Calif., and by landowners in Mexico, will be commenced as soon as the courts permit the California Development Co. to resume work in Mexico. The courts in Lower California, some time ago, ordered W. H. Holabird, Receiver of the company since its financial difficulties in 1909, to leave Mexico; and he went, taking with him men and machines. A. F. Andrade, the Receiver of the Mexican branch of the company, does not possess sufficient resources to prosecute the urgently needed repairs.

Mr. Holabird said on Oct. 30 that he proposed to petition the courts to cause Mr. Andrade to let a contract for this construction and dredging work, the contractor being a dummy who will sublet the contract to Mr. Holabird. The latter stated the program of work in a letter to J. C. Allison, Assistant General Manager and Chief Engineer of the California Development Co., at Calexico, Calif. The work, estimated to cost $300,000, will cover the following items:

1. Dredging in the upper end of the West Side main, to put it in shape for water deliveries in both countries. 2. The building of a new system for transporting water across the New River to supply water to the West Side main. For this a dam across the river or a flume will be necessary. If a flume is built, it is believed that it will have to be considerably higher than the present one. The cost of these two items will approach $100,000. 3. Dredging with the dredge "Delta" in the Alamo Canal to remove sand bars. The "Delta" is one of the largest dredges in the world. 4. Rebuilding and putting into service the dredge "Gamma." This dredge has sunk, but much of it can be recovered. 5. Repairs to the waterway known as "134 wasteway," which is designed for use in diverting the waters in the canal in case of emergency. 6. The possible rebuilding of the present heading which diverts water at Sharp's heading into the Encina Canal, which carries water to the West Side main, by way of the flume mentioned in paragraph two. 7. The immediate completion of dredging in the East Side main between the East Side heading, on the Alamo, and Allison heading, near the line, where the water is divided for use in the east side territory. This territory includes the 100,000 acres which will be put under cultivation as soon as the laterals have been built westward from the new East Side main.

An article by J. C. Allison, published in "Engineering News," of Jan. 9, 1913, pp. 66-70, outlined the irrigation system of the California Development Co. In the Imperial Valley, the water used for irrigation purposes reaches as high as 93,000 acre-feet per month, distributed over 245,000 acres of land, in holdings which average 160 acres each.

Dual Water-Supplies and Typhoid Fever at Philadelphia

The dangers from permitting connections between private water-supply systems for industrial plants and city water-works systems have been shown again and again during the past ten years. The dangers arise from the fact that these private water-supplies are often polluted and, even when check valves are used to prevent the polluted water from gaining access to the public mains, accidents, leaks, or shear negligence permit more or less direct and complete connections, sometimes with fatal results through typhoid outbreaks.

The latest instance of evident water infection of the kind just noted, with consequent typhoid, comes from Philadelphia. In that city, after a notable falling off in typhoid since the city was wholly supplied with filtered water, there has been a mild but worrisome increase for some months during the present year. This has led to a detailed study by the Bureau of Health, which has recently called to its aid the State Department of Health and Prof. Geo. C. Whipple, of Harvard University and New York City, as noted in more detail below.

At the recent September meeting of the American Public Health Association, Dr. Joseph S. Neff, director of the Department of Public Health and Charities, of Philadelphia, read a paper reviewing this typhoid outbreak. Some facts from that paper* are presented below, supplemented by a later statement from J. A. Vogleson, chief of the Bureau of Health, of Philadelphia.

Dr. Neff states at the outset that for several years past "the causes of Philadelphia's typhoid infection have been fairly constant." and that they have been divided as follows:

	Per cent.
Contracted outside city	20
Drinking raw river water	24
Milk infection	10
Contact	4
Unknown (probably due largely to flies, foodstuffs and carriers)	42
	100

From Apr. 26 to July 4, there were 418 cases of typhoid reported, compared with 357 cases for the corresponding period in 1912. An examination of the records "showed the effluents from all the filtration plants to be free from infection," besides which the effluents were being treated with hypochlorite.

A classification of the 418 cases showed 122 among school children, 41 among various houseworkers, 23 laborers and the remainder scattering from 8 cases to 1 case per occupation. A total of 118 occupations was involved. The milk supply and various other common routes of infection were studied without throwing material light on the problem.

Further studies, which it is unnecessary to detail here, pointed to the water-supply, notwithstanding its character on leaving the treatment works. Of a half-dozen water districts into which the city was divided it was found that one of these (called "D") had charged against it no less than 317 of the 418 cases, and that 309 of these 317 cases drank city water.

Examinations of water samples taken within this district showed B. coli "intermittently in both 10 and 1 c.c." samples. The closing portion of Dr. Neff's paper follows:

*The paper will appear in the "Journal" of the Association.

It seems fair from the foregoing data to eliminate all causes of infection except water, which is found to be intermittently polluted at various locations in the infected area.

It had been learned that a large number of manufacturing plants have in use a dual piping system—one system carrying city filtered water and the other raw polluted river water. Check valves are said to be in use; but it cannot be determined whether or not these are kept closed or that they do not leak.

Most of the manufacturing plants are in the infected area. There are said to be some, however, in District "B." If this is the case, the absence of pollution can be accounted for by the water pressure in this district, which is 175 lb., sufficient to withstand the counter pressure of the pumped river water. In District "D," however, where the pressure at times is lower than 20 lb., the raw river water coming into the city service pipes under a very much higher pressure, must flow back for considerable distances into the service pipes.

In view of this condition, the local Board of Health passed, under date of June 20, the following resolution:

WHEREAS, It has come to the knowledge of this Board that it is the practice in this city to install in certain instances water-piping systems whereby water from city mains and from other sources can be alternately used in such piping systems, and

WHEREAS, It has been found that the city mains in localized sections are now subject to periodic contamination, and

WHEREAS, systems of piping which possess the possibility of allowing contaminated water to enter the city's distribution system have a tendency to be prejudicial to the public health, therefore, be it

RESOLVED, That an actual physical severance shall be maintained between piping connected to the city mains, and piping carrying water from any other source, and that the Director of the Department of Public Health and Charities is hereby authorized and directed to cause the severance of all such dual systems in use, and to prevent the construction of any future system of like character.

As the difficulties seemed great and as there was considerable divergence of opinion, the Surgeon-General of the United States Public Health Service promptly sent, upon request of the writer under date of June 18, Passed Assistant Surgeon W. H. Frost, to go over the records collected, who, after a careful study of all the epidemiologic data at hand, made a report to the Surgeon-General, under date of June 23, confirming the conclusions already arrived at. At about the same time, F. Herbert Snow, chief engineer of the Pennsylvania State Department of Health, after a conference with the local authorities, was quoted as having confirmed these findings.

The conclusion reached is that the cause of the increased incidence of typhoid fever in Philadelphia has been due to pollution of the city service mains; and, in the absence of any other known cause of contamination, it is fair to assume that this pollution is caused by the dual piping system in certain manufacturing plants.

Under date of Oct. 7, 1913, Mr. Vogelson, in reply to an inquiry from this journal with which reply he transmitted the paper just abstracted, wrote to us as follows:

Supplementing Dr. Neff's paper, I may say that the mild epidemic therein described has continued throughout the summer, reaching a maximum of 75 cases reported during the week ending Aug. 16, and while the cases reported per week have since declined, there is still too great a number occurring.

Attention was early directed to the intermittent contamination shown by analyses of water drawn from taps of city mains in localized sections of the city. These samples showed at times low bacteria counts without coli, and again high counts with coli present. The high typhoid rate was confined to wards adjacent to some of the manufacturing districts and the river fronts, all in the section supplied by the Torresdale filters, which were continually delivering an effluent low in bacteria and without coli. This water was consistent in good quality throughout the force mains, and passed through and was delivered to several populous wards where typhoid has maintained a low rate before the wards with increased rates were reached. The entire city supply has been filtered since November, 1911, and disturbance of sediment caused by changing of distribution districts or local disturbances caused by heavy drafts during fires, or any other of the changes to which a distribution system is ordinarily subjected, could not longer be accepted as the probable cause for the intermittent contamination.

Attention was then directed to establishments maintaining pumping plants of their own, which draw their supplies from creeks, rivers or wells, and in whose piping arrangements check or stop valves are interposed to separate their raw supply from the filtered water now supplied by the city.

CONCRETE TEST PIECES IN SEA WATER IN BOSTON HARBOR

[Pieces 16x16 in. x 16 ft. Placed Feb. and March, 1909, by Aberthaw Construction Co., Boston, Mass.]

No.	Cement	Mixture	Amount water	Remarks	Condition—Oct. 31, 1912
1	Normal portland	1 : 1 : 2	Dry		Back and sides in good condition. Face porous and eroded.
2	Normal portland	1 : 1 : 2	Wet		Good condition.
3	Normal portland	1 : 1 : 2	Very wet		Back and face slightly eroded; otherwise good condition.
4	Normal portland	1 : 2½ : 4½	Dry		Face badly eroded entire length, most at mid-tide. Back and sides good as when placed, but poorly spaded.
5	Normal portland	1 : 2½ : 4½	Wet		Good condition.
6	Normal portland	1 : 2½ : 4½	Very wet		Good condition; edges at low tide slightly worn.
7	Normal portland	1 : 3 : 6	Dry		Very poor condition. Portions entirely submerged and entirely out of water in good condition, but portion affected by tide badly eroded to maximum depth of 9 in.
8	Normal portland	1 : 3 : 6	Wet		Face and sides good. Back eroded in mid-tide section, depth 4 in.
9	Normal portland	1 : 3 : 6	Very wet		Good condition.
10	No iron in cement	1 : 1 : 2	Wet		Good condition.
11	No iron in cement	1 : 3 : 6	Wet		Good condition.
12	High alumina cement	1 : 1 : 2	Wet		Good condition.
13	High alumina cement	1 : 3 : 6	Wet		Back slightly flaked at low tide, mid-tide edges eroded.
14	Low alumina cement	1 : 1 : 2	Wet		Good condition.
15	Low alumina cement	1 : 3 : 6	Wet		Back slightly flaked at low tide.
16	Iron ore cement	1 : 1 : 2	Wet		Good condition.
17	Iron ore cement	1 : 3 : 6	Wet		Slightly scaled on all sides, 3 ft. above low water.
18	Slag portland cement	1 : 1 : 2	Wet		Back slightly flaked at high tide for 3 ft.
19	Slag portland cement	1 : 3 : 6	Wet		Back badly eroded below high water mark, depth 3 in. Face and sides slightly eroded at low tide. Back very soft. Edges eroded below high water.
20	Normal portland	1 : 3 : 6	Wet	Extra mixing	Four sides slightly eroded at low tide.
21	Normal portland	1 : 3 : 6	Wet	Sea water used	Lost.
22	Normal portland	1 : 3 : 6	Wet	Add 10% hyd. lime.....	Edges badly eroded at mid-tide, depth 4 in., length 2 ft. Low-water faces slightly eroded.
23	Normal portland	1 : 3 : 6	Wet	Add soap and alum.....	Edges badly eroded at low tide, depth 3 in., length 4 ft. Edges on front face slightly eroded for whole length.
24	Normal portland	1 : 3 : 6	Wet	Add 5% colloidal clay	Edges slightly eroded, otherwise good.

We have termed such arrangements "dual piping systems," and the Board of Health has by resolution declared all such piping systems in this city to be a menace to the public health, and in coöperation with the Bureau of Water is proceeding with their elimination. One hundred and forty (140) establishments were reported to the Bureau of Health as having, or possibly having, such dual water systems, and attention was first given to these plants with a following decrease in contamination and typhoid rate in some of the affected wards.

As was previously stated, the force mains have shown good water. The intermittent contamination has appeared in the distribution laterals. The city is divided into zones for sampling purposes and contaminated sections are being circumscribed as rapidly as possible to the end that all dual systems be eliminated and that all pipes shall furnish as good water as is delivered by filters.

The typhoid rate for the city has declined slightly, and markedly in some of the affected wards where the reported dual systems have been removed, but in order to leave no stone unturned in the typhoid inquiry, Prof. George C. Whipple, of Harvard University, and Dr. Samuel G. Dixon, of the State Department of Health, were communicated with, the latter being represented in the field by Mr. F. Herbert Snow, Chief Engineer of that Department, and are assisting the city authorities in an examination which is directed toward all the probable causes of typhoid fever.

A Four-Year Test of the Effect of Sea Water on Concrete

In February and March, 1909, the Aberthaw Construction Co., of Boston, Mass., placed in Boston Harbor 24 concrete columns, made of different mixtures and in different manners, according to a prearranged schedule, with the idea of examining these columns from time to time, to ascertain if possible the effect of sea water upon concrete of different constituencies. These test pieces were suspended from one of the old piers of the United States Navy Yard at Charlestown, and November, 1912, they were moved from the original location to a new one. At that time, opportunity was had to examine carefully the condition of the various pieces. The results of this examination are noted below. We are informed that such examination of the pieces as can be had without taking them from the water shows that their condition now is about the same as it was when this record was made.

As noted in ENGINEERING NEWS, Dec. 24, 1908, p. 730, the test pieces were very carefully made of portland cement (with the variations in makeup noted in the accompanying table), sand and crushed stone. Uniformity of methods in manufacturing was observed in all the pieces; fresh water only was used, except in specimen 20, in which sea water was used for mixing. As will be noted in the table, this specimen was unfortunately lost in moving. After the pieces were cast, they were allowed to set in water for five days and in air for five weeks, after which they were suspended from the pier in such fashion that the lower end is always under water at all tides, and the upper end is always above water at all tides.

It will be noted from the table that most of the pieces are in good condition, and it is rather difficult to make any generalizations regarding the conditions that have brought about failure in the cases where failure has occurred. It may be noted that the "back" as reported is the lower surface of the column, which was cast horizontally. The "face" is the top screeded surface, and the "sides" are the vertical sides. The specimens are placed quite near to the well known concrete dock which showed such serious signs of deterioration, as noted in ENGINEERING NEWS, Aug. 27, 1908, p. 238. Boston Harbor is subjected to severe freezing conditions in winter, so that the test is an indication of the physical action of ice and frost as well as the chemical action of the sea water proper.

Engineering Society Headquarters in London have been greatly altered during the past three years. The Institution of Civil Engineers was obliged to give up three years ago the house which it had for many years occupied because the ground on which it stood was condemned to make room for an extension of the government building. A new site was procured by the Institution on the opposite side of Great George St. and upon this site there has been erected a monumental stone building three stories in height and covering an area about 120x160 ft. The building contains two large auditoriums, one the great hall, 45x100 ft., and a smaller lecture theater, 45x60 ft. The building is not quite completed, but is sufficiently far advanced so that it is already being used by the Institution.

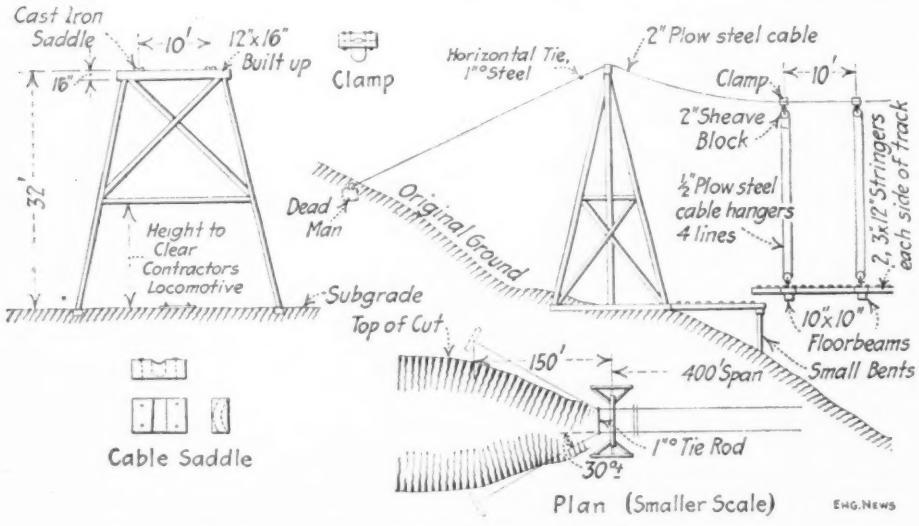
The Institution of Mechanical Engineers, which has a well located and spacious building in the same neighborhood, has made extensive alterations and additions to its property during the past three years, and the house in its present condition is one of which any engineering society may well be proud.

A third British engineering society, the Institute of Marine Engineers, which is an extremely important society by reason of the prominence of shipbuilding among British industries, has just laid the cornerstone of a new building for its occupancy, located on Tower Hill. The building will cover an area of about 2500 sq.ft. and will cost about $50,000.

FIELD AND OFFICE

A Suspension Dumping Bridge for Building Railway Embankments

In building railway embankments of considerable height, cable dumping bridges have been used in a number of cases. A bridge of 400-ft. span was used by J. C. Carpenter on the construction of the new line of the



CABLE DUMPING BRIDGE FOR BUILDING EMBANKMENTS; LOUISVILLE & NASHVILLE R.R.

Louisville & Nashville R.R. from Winchester to Irvine, Ky. It is shown in the accompanying drawing for which we are indebted to John Howe Peyton, Chief Engineer of Construction, L. & N. R.R.

Each tower is composed of a pair of A-frames, braced together and carrying a heavy built-up cap. Upon the caps are placed cast-iron saddles for the two cables, which are of plow steel, 2-in. diameter. On the anchorage sides, the cables are led to deadmen embedded in the ground about 150 ft. from the tower. Near the top of the tower they are connected by a 1-in. steel tierod, and beyond this they diverge at an angle of 30° to the anchorages. The cables are 10 ft. apart, and at intervals of 10 ft. there are suspenders or hangers secured to hooks clamped on the cables. These suspenders are four-line tackles of ½-in. steel cable, having the upper block hooked to the clamp on the main cable and the lower block hooked to a belt in a floorbeam 10x10 in. The stringers for the track ties rest on the beams. Each stringer is made up of two timbers 3x12 in. The track is laid for a length sufficient for six small dump cars. The first section of the floor is supported upon small bents, as shown, the bridge floor beginning where the height becomes too great for such bents.

The timberwork is fully explained by the sketch. These bridges are cheap, and with reasonable care give no difficulty in handling.

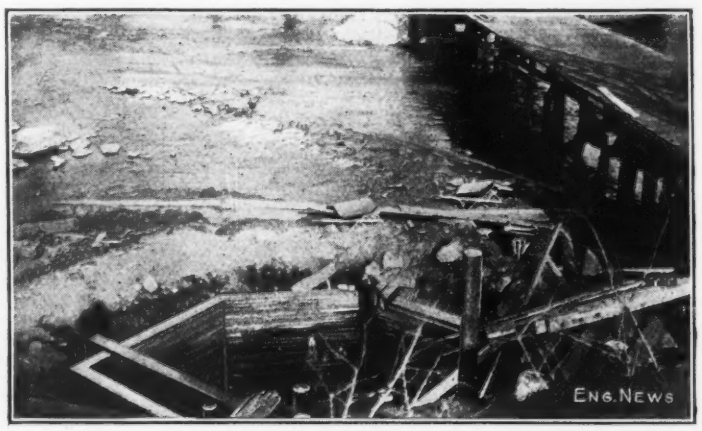
The fills on this work are not very long, as a rule, but many of them are 50 to 90 ft. deep, so that it was impracticable to build temporary dumping trestles.

A Self-Draining Foundation Pit on the Bank of a River

BY JOHN W. CUNNINGHAM*

An unusual condition in foundation work was encountered during the excavation for piers at the Oregon-Washington R.R. & Navigation Co.'s viaduct across the Spokane River within the city limits of Spokane, Wash.

For one of the piers coming just at the bank of the river a plank crib of the common pattern was built, and preparations were made for handling a moderate amount of water. The excavated material was thrown out on the river side of the crib to form a dike. For the first 2 or 3 ft. the excavation was in fine compact sand with some boulders. A small quantity of water which seeped through the dike and ran through the loosely constructed crib, or came up from the bottom of the pit, was easily handled by hand pumping. At a depth of about 4 ft. a coarser gravel was encountered, and at the same time the seepage from the bottom of the crib stopped, and *the accumulated water ran out.* It was found that the flow through the sides of the crib was entirely absorbed by the material at the bottom, although the excavation was considerably below the level of water in the river. This condition continued until the full depth of excava-



CRIB PIT FOR A BRIDGE-PIER FOUNDATION AT SPOKANE, WHICH WAS SELF-DRAINING 10 FT. BELOW RIVER LEVEL

tion was reached (about 10 ft. below river level), piles driven, and the footing concreted.

While no further investigation was made to find the cause of this phenomenon, the most plausible explanation seems as follows: The topography of this region has been

*Portland, Ore.

ltered by both lava flows and glaciation, and it is likely hat the Spokane River has been shifted from its original ed by obstructions. The underground flow and the slope f the water table are possibly still toward the axis of the original valley, perhaps miles from the present course of the river. The existing river bed has been silted up until it is almost impervious, and the river is carried through the pervious gravels in a watertight trough, some distance above the level of groundwater. In the instance stated, the upper stratum of fine material was the silted deposit from the present river, while the gravel below was possibly the undisturbed glacial gravel with which the entire valley is filled.

The writer would be glad to know of similar experiences in excavation work, or to have the condition explained by one more conversant with geological phenomena than himself.

Rapid Erection of a Steel-Frame Foundry

A rapid erection job was done by the Worden-Allen Co. last month in putting up the steel frame of a new foundry for the National Brake & Electric Co., Milwaukee. The frame, containing 536 tons of steel, was erected complete in 56 hr. working time. The three photographs herewith show the condition of the work at the end of the first, fourth and sixth days. The latter shows the building frame nearly completed. In the time specified not merely the main supporting members were placed, but all bracing, purlins and other steelwork complete. The riveting was not done, of course, the work being left bolted. The erection went on at the rate of nearly 10 tons per hr.

FIG. 1. FIRST DAY'S WORK

The building is arranged in two bays, 81 and 60 ft. wide, respectively, both running the full length of the building, 275 ft. The framing comprises 20 panels of 13 ft. 9 in. The wider bay is the foundry bay. It has a standard monitor roof, and contains a 50-ton overhead traveling crane of 76 ft. span, and wall tracks for 5-ton traveling jib cranes of 14-ft. reach. The narrow bay is the flask-room. It is covered by transverse trusses on which sawtooth roof construction is supported; the columns carry a 10-ton electric bridge crane with a span of 58 ft. 4 in. The photographs make the arrangement evident. The six lines of crane-girders are to be noted.

Erection was handled by a steel derrick-platform 30 ft. square, resting on traveler wheels of turntable type, so that the platform can be easily moved on a steel track laid on the ground. The platform carries two stiffleg derricks at the two forward corners, with 75-ft. steel booms. Any point in the width of the building could be reached by either boom or both. The booms could thus coöperate wherever necessary, which eliminated a considerable amount of lost time when setting unsupported steel parts, as one boom could, for example, place and hold a column while the other dropped a connecting girder into place and so tied the column. The booms had separate hoisting engines.

Erection was started 11 a.m. Friday, Oct. 2, and was completed 4:30 p.m. Saturday, Oct. 10. In this time, however, the first Saturday afternoon was a half holiday; four hours' time was lost during the following week, and on another day the weather conditions were so bad as to make work practically impossible. The time of 56 hours above stated is the net working time; it happens to just equal seven regular 8-hr. working days.

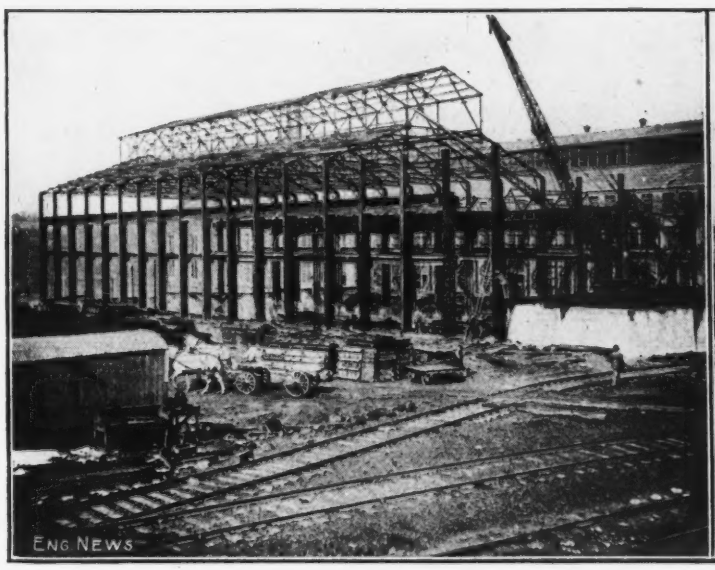


FIG. 2. END OF FOURTH DAY

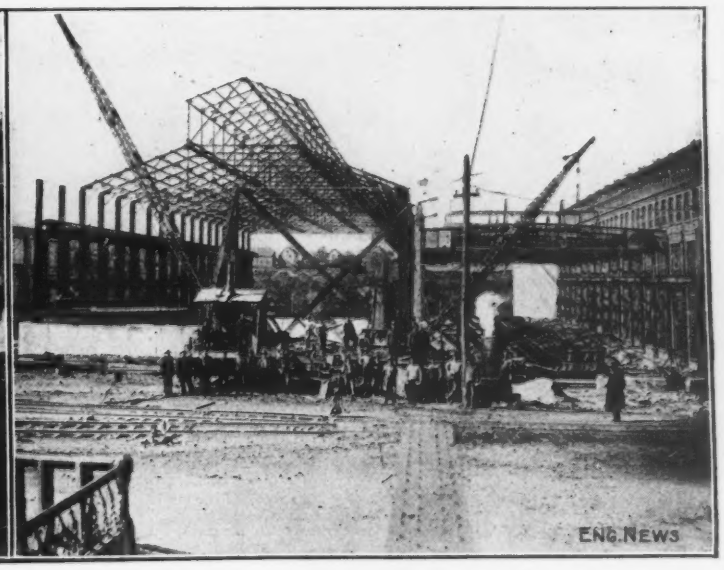


FIG. 3. END OF SIXTH DAY, BOTH BAYS NEARLY COMPLETED

Early Piledrivers

The piledriver has always been one of the most important machines in civil-engineering construction, as piles were the only (or at least principal) means of securing reliable foundation in soft ground, until a recent epoch. The present-day contractor may well wonder how his predecessors before the time of the steam engine carried out their pile-driving jobs. We have compiled some sketches from models and old drawings in the great German technological museum at Munich (Deutsches Museum), which give a fairly comprehensive idea of old pile-driving machines.

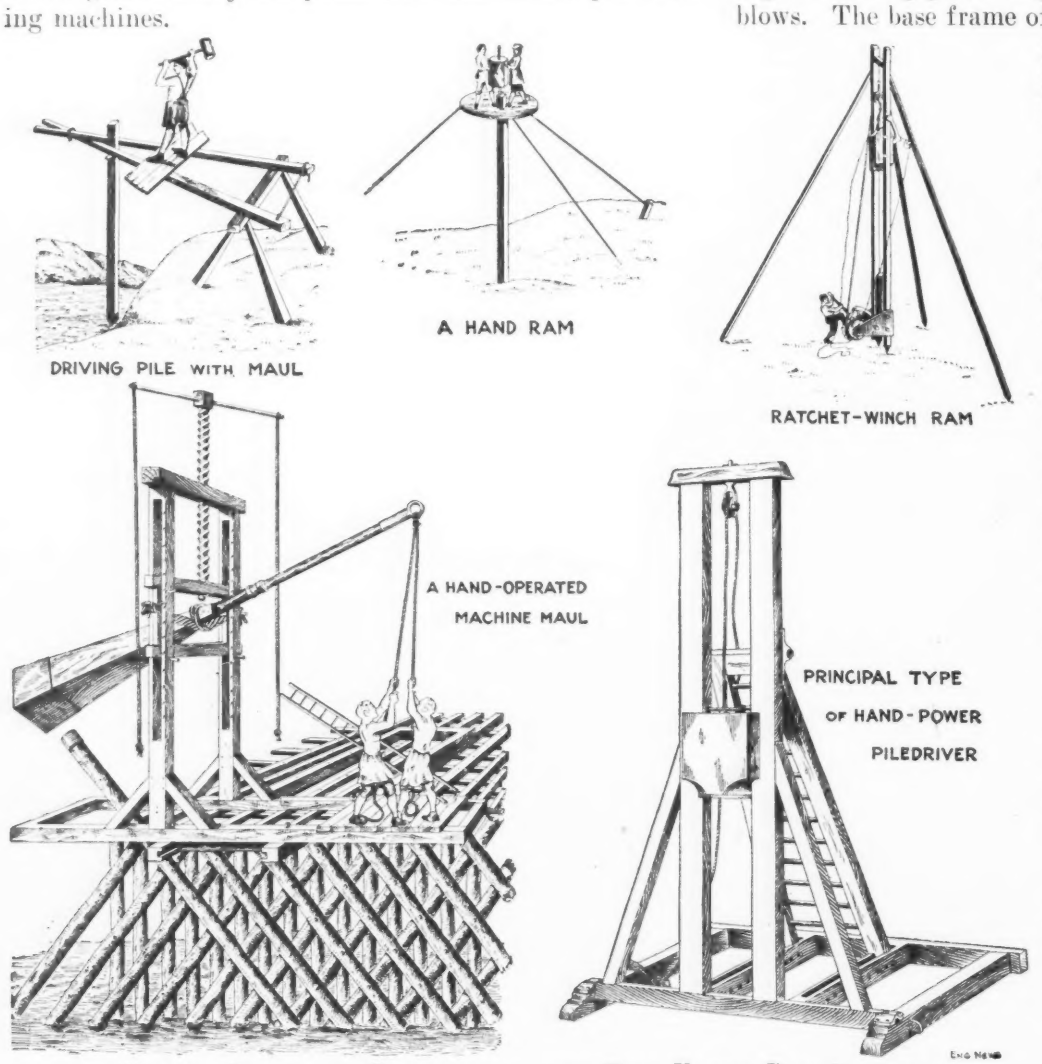


FIG. 1. PRIMITIVE PILEDRIVING, AND TWO EARLY RAM DRIVERS

To begin with very primitive methods: Driving with a maul is shown in the small sketch at the upper left corner of Fig. 1. Below is a machine for the same purpose that may be called a hand-operated machine maul; it was adaptable to inclined piles. The problem of driving batter piles was, in fact, of great concern to the old builders, as considerations of stability often demanded such piles. Another primitive device, lacking the idea of a machine, is the one sketched at the top middle in Fig. 1; it is interesting as presenting the ram idea in most simple form. A guide rod or bolt driven into the top of the pile served as guide for the ram, which had a hole in it to slip over this rod.

The three sketches just referred to are from a medieval work on construction. Probably they represent devices which even then were only of historical importance, for the same work sketches the machine piledriving ram at top right in Fig. 1. Here the essential elements of the piledriving machine are present: a pair of leads, a ram moving between them, a hoist rope led over a pulley at the top, and a winch for hoisting. In this case a ratchet winch is used, so that one man can lift the ram. It is not apparent how the ram was released; possibly it was released simply by throwing out the ratchet pawl.

The machine of doubtless most extensive use until relatively recent time is the rapid-stroke gang driver shown in the lower right corner of Fig. 1, sketched from a model in the museum. Here the tail of the hoist rope was fitted with grips for eight or ten men, who by pulling and letting go could give a fairly rapid series of short blows. The base frame of the driver was fitted for inclining the leads by setting back the rear brace legs in slots of the base as shown.

The application of the winch to piledrivers is shown in various forms in Fig. 2, also sketched from models in the museum. An essential requisite in such machines is a ram trip. Various forms of releasing hook are shown, tripped by hand or by fixed (probably in some cases movable) dogs. The nature of the releasing devices is clearly enough shown by the sketches to require no special reference. It is worth remarking, however, that the scow driver shown at the right at the bottom probably had a clutched winch-drum, instead of a releasing hook. There are cases in which both devices were used, the releasing drum then being probably a time-saving device in returning the rope to pick up the ram after a blow.

We have to thank Dr. Oskar von Miller, Munich, Germany, founder and president of the Museum, for photographs of the models and for the opportunity to make sketches in the museum.

These old-time piledrivers make it specially interesting to find, in inspecting German construction work, that steam-hammer piledrivers there are generally worked with manual operation of the steam valve.

In different jobs carried out by first-class contracting firms, in both land and scow driving, one man was constantly occupied at the valve rope, giving it a pull for every blow. On inquiry it was explained that this style of steam-hammer driver was used because automatics are not yet in a satisfactorily perfected state.

With further reference to the above historical sketches, a note on American piledriver construction of 1841 may be of interest. It indicates that power piledrivers were exported to Europe from America even 70 years ago. The item was reprinted by the *American Railroad Journal* from the Oneida (N. Y.) *Whig* of the same year, and reads as follows:

STEAM PILEDRIVER—Messrs. Pond, Higham & Co., the enterprising proprietors of the Vulcan Iron Works in this city, have just completed a machine for driving piles, which

is to be sent out to Liverpool, England, from whence it was ordered by a company who have taken large contracts on the great Russian railroad. This machine, which we saw in operation on Tuesday last, is worked by steam, and with half a dozen hands to manage it, is capable of performing the labor of 200 men and 20 old-fashioned piledrivers. It carries its own locomotive, sets up the piles, drives them, and cuts them off at a proper grade with a circular saw.

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Planer Shavings and Cement are used by the construction forces of the Southern Pacific Co. as a plug in tremies for depositing concrete under water. As is well known, in using bottomless tremies in deep water the concrete in the first charge has to be deposited through the tremie full of water, thus defeating the purpose of the tremie, which is to avoid the separation of the concrete as it falls through the water. To get around this difficulty a number of schemes have been used, notably the use of a burlap plug or in extreme cases a flap bottom to the tremie. In the practice of the above named company, however, the tremie is first put down in the water and upon the top surface inside the tube is sprinkled a layer of planer shavings and cement. On top of this plug the concrete is deposited, pushing the plug ahead as the tube is filled, thus allowing the concrete to be placed in a comparatively dry tube. When the plug reaches the bottom the larger part of the shavings and cement goes out of the bottom and floats to the top.

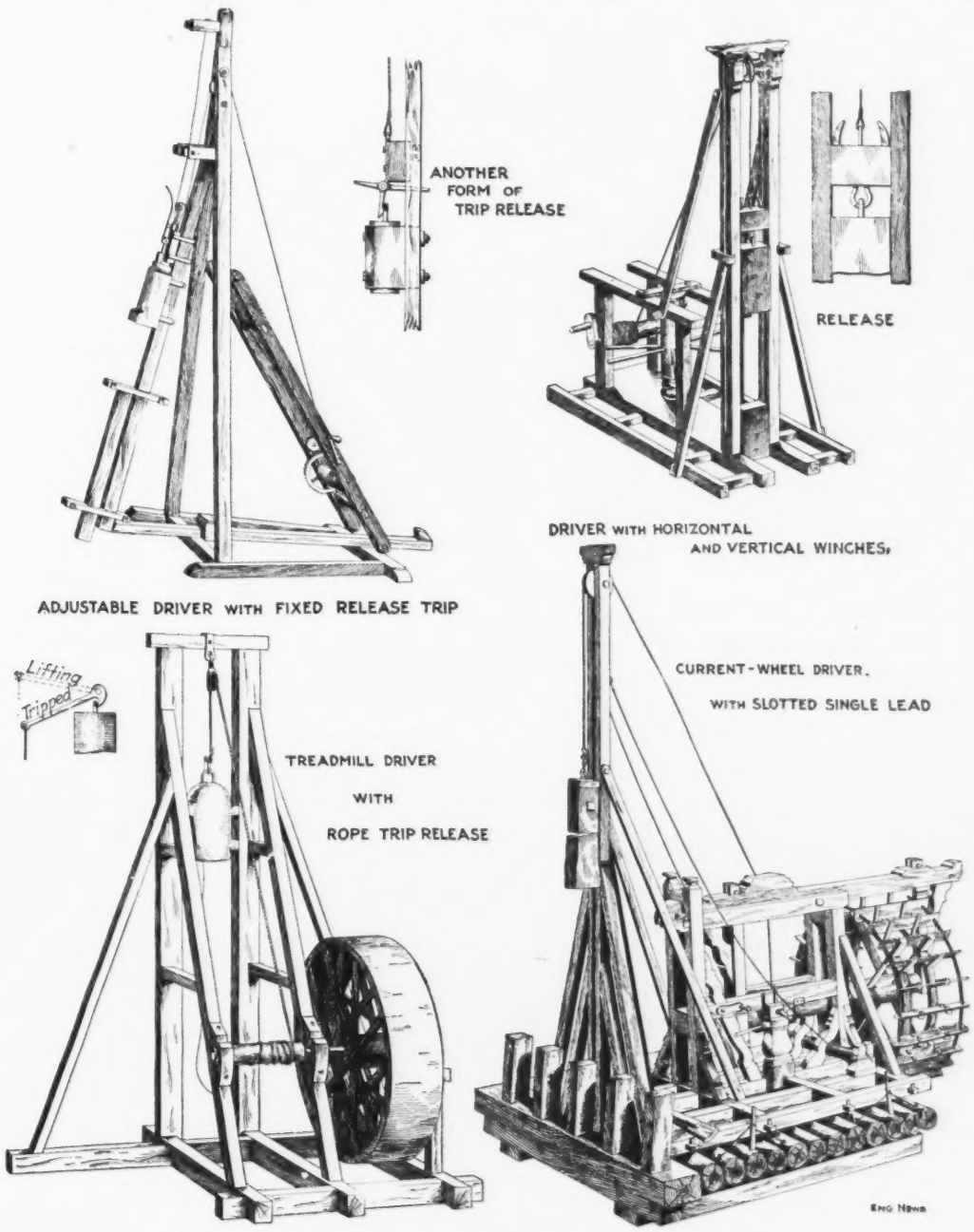


FIG. 2. FOUR MEDIEVAL WINCH PILEDRIVERS WITH VARIOUS WINCH AND TRIP ARRANGEMENTS

Sewer Construction in Quicksand

Trenching and sewer construction (or pipe laying) in quicksand formation is a work to try the resources of both the engineer and the contractor, not only in the actual work of construction but in insuring that the sewer will stay in place after its completion. In some such cases, the material is transformed to a stable condition by unwatering the sand by means of drains and well points. But where the material is of a muddy and sticky character, the water cannot always be separated. A case of this latter kind as encountered by Charles P. Chase (Clinton, Iowa), at West Liberty, Iowa, in 1911.

The material was a silt deposit of some ancient lake bed, and it would flow like water. It varied from a fine silty sand to a molasses-like mud, in which men frequently sank to their hips and were pulled out with ropes. The use of sand points or well points failed to drain the mass, as the water would not separate, the material holding together like paint. The methods of carrying the work through this unstable material are described* by Mr. Chase as follows:

The first encounter with this was fought out in the usual way, with hand-driven sheeting, afterward removed. One block, about 300 ft. long, was in good shape when finished; but later the sides settled and the whole line was heaved out of line and grade and nearly every pipe crushed.

The various ordinary expedients of sewer building were tried without much success. The first was to take out a small section by hand, driving the sheeting down as the excavation proceeded. When to grade, short shiplap was driven about 2 ft. below grade and left 2 ft. above. Straw, cinders, stone, brickbats, and other material simply floated away, the great trouble being that after the pipe was laid the bottom of the trench would rise up from pressure of the sides and break open the joints, or even crush the pipe.

It was seen that more strenuous and thorough methods must be adopted, and that perfectly tight sheeting must be used of sufficient strength to hold side pressure, and that it must be secured and left in. It was also found to be impossible to depend on hand-driving as the trench was excavated. A Vulcan steam hammer was tried, but was exchanged for an Arnott hammer, and a systematic outfit arranged. To prepare for sheeting, the ditch was opened with a trenching machine as deep as the banks would stand, which was from 6 to 9 ft., much better success attending machine digging than hand digging here. Then 2x12-in. tight sheeting was driven about 3 ft. below the grade of the flow line of the pipe. This was thoroughly cross-braced and spiked, and was left in the trench. Any attempt to remove

*"Proceedings" Iowa Engineering Society, 1913.

the sheeting was attended with almost immediate disaster to the pipe.

Two methods of placing and driving the sheeting were employed. In both cases the excavation was first carried down 6 to 9 ft. with a trenching machine, temporary braces being set to hold the joint-clay banks until the stringers could be placed. In the first method, a set of 4x6-in. stringers was placed at the bottom of the machine-dug trench, a 2x6-in. stringer being placed next to the bank and separated from the 4x6- by a 2-in. block. Much care was taken to have them set plumb, or the sheeting would drive crooked. A similar set was placed about 3 ft. below the surface of the ground, and the sheeting was driven between the 2x6-in. and the 4x6-in. timbers by an 85-lb. steam hammer. A timber frame 16 ft. high was constructed on a platform wide enough to span the trench, and the hammer was suspended from a trolley running on a 7-in. I-beam set transversely to the trench at the top of the frame. The platform was built on skids parallel with the trench so it could be easily moved forward as the driving progressed. The hammer was operated between two pairs of guide rods made of galvanized-iron pipe, a gasoline engine and hoist being used. With this method and equipment an average of about 60 pieces 2x12-in. x 18 ft. long, could be driven per day at a cost for labor of 50c. per lin.ft. of trench and a total cost for sheeting of about $3.20 per lin.ft. It was hard to keep the outfit upright and steady, which took away much from the driving power. Only one plank could be set on each side of the trench at a time, making it necessary to move every foot, which was impractical and too expensive.

In the second method, blocks were set between the 4x6-in. stringers, and the 2x6-in. stringers were omitted. The steam hammer was handled by a derrick with a 20-ft. boom, the guide rods in this case being made fast to the hammer and sliding through iron loops fastened to the end of the boom. The derrick was erected on a platform as described above, and so that the foot of the derrick was over the center of the trench.

In this way about 34 piles could be driven from one position of the derrick, which was then moved forward and the driving continued. Laborers set the sheeting ready for the driver as soon as the stringers were in place, so the hammer could be kept constantly at work. With this method the number of sheet-piles driven per day was increased about 30%, with a corresponding decrease in cost.

The quicksand was taken out in ¼-yd. buckets, to handle which two derricks of 6x6-in. timbers, with 20-ft. booms, were erected on opposite ends of a platform made to span the trench. A four-post frame made of 6x6-in. timbers, properly braced, held the derricks in place. On the platform within the frame, a 4-hp. gasoline engine furnished power for the hoists, which were so arranged that one man could operate both derricks. This is the same apparatus mentioned above, which was used to handle the steam hammer, and hitched to a scraper was also used for back-filling. The blocks were so arranged that in raising a full bucket from the trench its weight pulled the boom around to the side of the trench where the bucket was to be emptied. Seven men were ordinarily sufficient to operate this device, doing more and better work than 14 had formerly accomplished by hand, and without it (or something similar) it would have been almost impossible to make any progress against the quicksand in the worst places. For in spite of tight sheeting, carefully driven, the sand ran in through the smallest cracks and boiled up from the bottom. Occasionally after a half day's work there were no results apparent in the trench.

With the sheeting in place, and the trench excavated, special methods had to be devised to prepare for pipe laying. Cinders, straw, brickbats, piling and concrete were used, and at last concrete was settled upon, first to keep the sheeting from pressing in and crushing or disturbing the pipe; and second to obtain a pipe bed. The concrete placed one day was not used to lay pipe on until the next day. Half of the diameter of the pipe was buried in concrete to distribute the weight and prevent crushing.

In some places where concrete was being placed for foundation, the sand boiled up from the bottom of the trench through the concrete before it had time to set and rendered it useless. To overcome this, 1-in. boards were laid lengthwise in the bottom of the trench, the full width, and nailed together. They were then worked down through the sand and water as far as they would go, sufficient excavation having been made so the boards could be worked down 6 or 8 in. below grade. The sand and water were then cleaned off the boards, and the concrete placed. The time saved in this way more than paid for the boards and a much better foundation was obtained.

Occasionally there would be an oasis in this sea of mud, where a good bottom could be secured by mixing cinders with it. This seemed to work where it was sticky, with clay predominating, as it would fill up and bind. But if fine sand predominated, cinders were useless. All pipe was eventually covered with dry earth and tamped for several feet.

RAILWAY CROSSING

Where the 15-in. main crosses the C., R. I. & P. Ry., an attempt was made to tunnel under the main tracks; but the sand was so bad that it was finally considered necessary to drive a temporary bridge of 15-ft. span under each of the two main tracks and make the excavation in open cut. Under the stringers of the bridges for a space of several feet, horizontal sheeting was set, and below this 2x8-in. sheeting was driven below grade by hand. Outside the main tracks steel sheeting was driven and later pulled by a 6-ton hoisting block, as cast-iron pipe was used across the right-of-way, and it was not thought necessary to leave sheeting in the trench.

As the sand offered no foundation for the cast-iron pipe, brickbats and concrete were placed under the joints. The excavation was carried down below grade, a wagon load of brickbats dumped at the place where the joint would come, and about ¾ yd. of concrete dumped from large buckets onto the brick. So much sand was taken out at this place that the banks settled considerably, over a foot at one point. This line of sewer, however, showed well on final inspection.

Steel Guyed Derricks for Building Erection

The erection of the steelwork of the 21-story Commercial and Continental Bank Bldg., Chicago, was done by means of steel derricks of the guyed type, which the erectors considered preferable to stiff-leg derricks. The steelwork can be erected about as rapidly with one type as with the other, but a guyed derrick can be moved up two floors and be ready for operation again within about two hours, while stiff-leg derricks require a considerably longer time to move and make ready for operation. With the latter also, the boom can work only through an angle of about 270°, while with the guyed derrick the boom can swing through the entire circle.

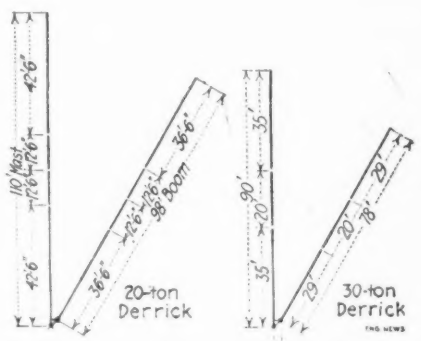


FIG. 1. DIAGRAM OF 30-TON AND 20-TON STEEL DERRICKS FOR ERECTING BUILDINGS

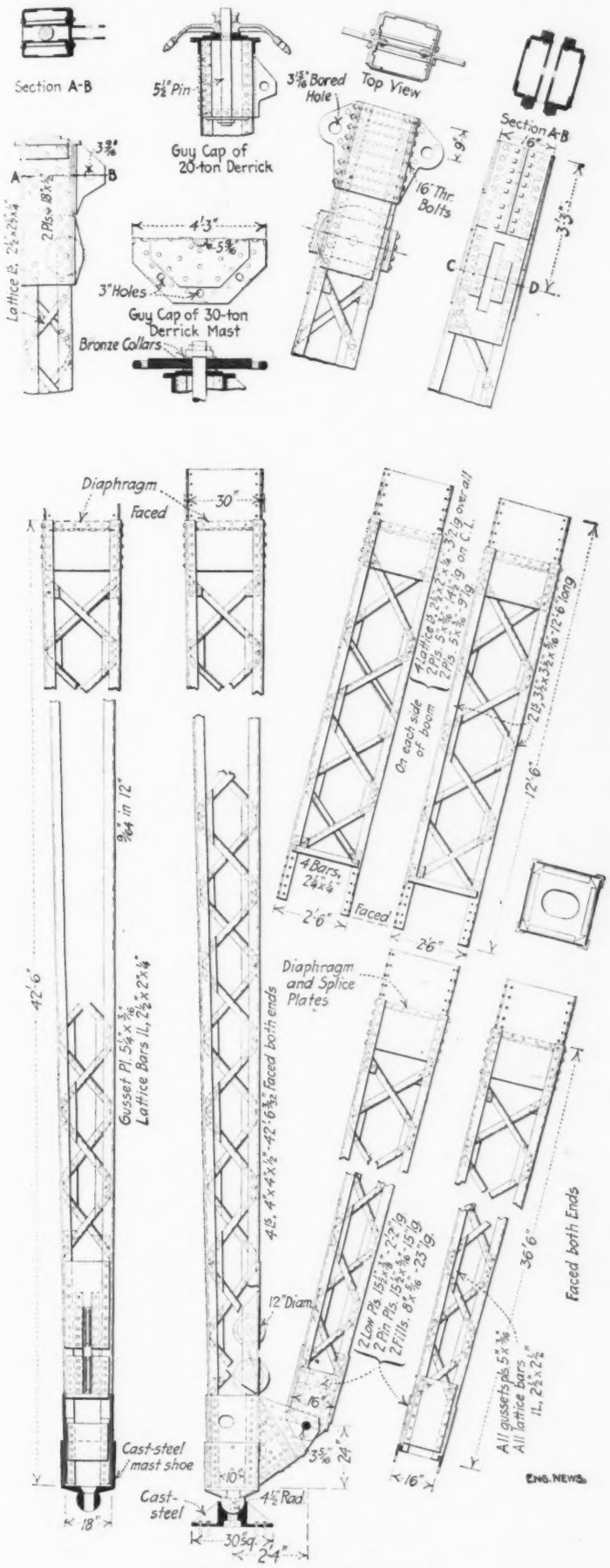
(Bergendahl-Bass Engineering & Construction Co., Chicago.)

The building is 324x166 ft. in plan and about 260 ft. high above the street level. The architects are D. H. Burnham & Co., whose engineering department designed the steel construction. The Thompson-Starrett Co. was the general contractor. The steel erection was done by the Bergendahl-Bass Engineering & Construction Co., to which we are indebted for drawings of the derricks and for other information.

There were six steel guyed derricks. Two of these were of 30 tons capacity, with 90-ft. mast and 80-ft. boom. The other four were of 20 tons capacity, with 110-ft. mast and 100-ft. boom. They could erect the columns and framing for two floors before being raised. Each derrick had the mast supported by eight guys of 1⅛-in. steel cable attached to a cap pivoted on the top of the mast. These were anchored at first to 1⅛-in. looped cables embedded in the concrete foundation piers for the columns, but

after the derricks were raised the guys were anchored to the steel columns.

The hoist of each 30-ton derrick was operated by an electric motor of 100 hp., while each of the lighter derricks had a 50-hp. motor. The hoists were first located in the basement, but were later moved to the first floor for the benefit of the enginemen. Signals governing the movements were given by bell cords operated by a man at each derrick, the bell being located near the hoist operator. The hoisting and topping lines consisted of ⅝-in. wire cables, with a four-part tackle for hoisting and three-part tackle for topping the boom. The derricks were swung by hand power, one or more men bearing against an 8-ft. horizontal pole connected to the lower part of the mast. The number of men depended upon the velocity of the wind, and in calm weather one man could swing the derrick easily.



DETAILS OF DERRICKS

(Most of the details apply to the 20-ton derrick; some 30-ton details are included.)

20-TON DERRICKS

The maximum reach is 95 ft. from the mast, with a load of 20 tons at that distance, and the boom can be swung to a vertical position.

The mast and boom are box-lattice girders, built up of four angles, with lattice angles on all four sides. Both mast and boom are built in four sections; the two middle sections of each are 12 ft. 6 in. long and enable the length to be varied as required for different work or buildings. The sections are faced at the ends and are put together with bolts in the splice plates; they are stiffened by diaphragm plates at the splices.

The foot of the 110-ft. mast has cover plates on the four sides, with side plates forming the shoe for the boom, which is fitted to a 3½-in. pin, while above these side plates is a heavy plate with 6x3½-in. angles in which are journaled two 12-in. rope sheaves. The foot of the mast is stepped into a cast-steel shoe having a spherical bearing formed on the bottom, this bearing resting on a cast-steel base. The chord angles are 4x4x½ in., with lattice angles 2½x2½x¼ in. riveted to the chord angles and to gussets or connection plates. The head of the mast is also fitted with plates, and has top plates riveted to flange angles. Through these top plates passes a 5½-in. pin 44 in. long, on which rides a cap 4 ft. in diameter, to which the guy cables are attached. The section of the mast is 18x18 in. at the shoe and the top, and 30x30 in. in the middle.

The 100-ft. boom has four corner angles 3½x3½x$\frac{5}{16}$ in., with lacing angles 2½x2½x¼ in., and is spliced in the same way as the mast. The bottom has cover plates on all sides, and pin plates for the 3½-in. shoe pin. The top also has cover plates. In cross-section the boom is 16 in. square at the bottom and top and 28 in. at the intermediate joints and in the removable portions. The top is fitted with a 20-in. sheave for the hoisting line and with lugs for attaching the topping lift and the swinging lines.

The parts are put together with ¾-in. rivets in $\frac{13}{16}$-in. punched holes; while the splices have $\frac{13}{16}$-in. holes for ¾-in. bolts. Contact surfaces were given a coat of linseed oil, and the work was given a coat of graphite paint when completed. The derrick was built by the Chicago Bridge & Iron Works.

30-TON DERRICKS

These had 90-ft. mast and 80-ft. boom, with a working reach of 75 ft. and a hoisting capacity of 30 tons at that reach. They are of the same design as the 20-ton derricks, but with only one removable section in the mast and boom.

The mast has chord angles 6x6x⅝ in., with lattice

angles 2½x2½x¼-in., and gussets of ¼-in. plate 5 in. wide. The spherical bearing on the cast-steel shoe rides in a bronze bushing in the base plate, and the head of the mast has an octagonal cap 51 in. diameter for eight 1⅛-in. guy cables. This rides between bronze collars on the 5½-in. pin. The boom has angles 3½x3½x$\frac{7}{16}$ in., with lattice angles and gussets the same as in the mast. This derrick was built by the American Bridge Co.

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A Field for the Inspector's Efforts

By Arthur W. Tidd*

The Question—Shouldn't the inspector interest himself in the contractor's methods and operations of conducting his work, and shouldn't he endeavor to effect improvements or changes in those methods and operations when it is evident that such are desirable, to the end that the very best quality of workmanship go into the structure that is possible under the specifications? Should he be satisfied with a "good, commercial job"? Shouldn't he strive for pleasing outline and finish as well as for sound concrete?

It would certainly seem that much could and should be done along these lines.

The Argument in the Affirmative—Take the job that is going along in a careless slipshod way. The results are certain to be inferior to the one that is proceeding in an orderly and systematic manner. The men will skimp their work at every opportunity and no amount of inspection can prevent it. The quality of the work done by a gang working with insufficient light, feeling their way around knee-deep in water, or trying to keep their footing on a slippery slope, is bound to be inferior to that produced where the unnecessary parts of such conditions have been eliminated and the men can give their full attention to their work. If the contractor's attention is continually being diverted by difficulties or accidents that could have been foreseen and avoided, some other portion of the work is bound to suffer.

Is it impossible to prevent bulges in the wall or offsets where the forms have joined? And isn't there something that needs fixing somewhere on the job that sees the engineer called upon over and over again at the eleventh hour to make concessions in order to get out of some complication that has arisen? Every engineer can recall scores of experiences of this nature. He ought to begin to inspect as soon as the excavation is started, and not wait until the sheeting fails or the bracing weakens to demonstrate what was apparent at the beginning. Taken up at the start, delays can be prevented and many trying conditions for both engineer and contractor attending the job avoided.

A few hints or suggestions to the superintendent, a word at the psychological moment or a tip to the foreman, are oftentimes all that are necessary to effect an improvement. Merely to point out clearly a condition that will arise later, will, in many cases, be sufficient to cause a change in the present methods. Sometimes the foreman needs educating, and if the matter is gone about in the right spirit, he will take it kindly. Sometimes you may have to convert him by means of persistent repetitions. Some men have that peculiar twist in their mental processes whereby continued allusions to one thing ultimately produce an effect upon their mind whereby they suddenly conceive the idea as having originated with themselves and promptly put it into operation.

It would seem that here is a field for the inspector's efforts. He is closely in touch with the physical conditions; he sees each part in its true relationship to the whole; he has sized up the general policy of the contractor, he knows the attitude of the superintendent and he is alive to the ability of the foremen; he has the experience and judgment of his superiors to fall back on to supplement his knowledge or advise him in his efforts.

It is granted that the situation is often a delicate one to handle, for unfortunately it is usually in the smaller details that this treatment is needed and the specifications seldom give the engineer any assistance. Patience, tact, ingenuity and persistence are needed, and it is not every inspector that has those qualifications even if he has the willingness. Then, too, his personality will be a large factor in the success of his efforts. In any event, he can accomplish something by bringing the details to the attention of the engineer, who could advise him from time to time or suggest a line for him to follow up. Often the matter is of sufficient importance for the engineer himself to take it up, his position entitling his suggestions to more consideration at the hands of the contractor.

It would seem that the sentiment so often expressed by the contractor, "This is my business, you let me alone and if the job isn't all right you can condemn it and I'll make it right," ought not to be taken literally. It would be far better to steer things around so that the "condemning" point was never reached.

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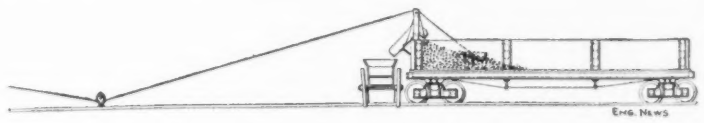
Unloading Broken Stone or Gravel from Cars by Scraper

By Ralph Bennett*

It is frequently the case that crushed rock and gravel are shipped to a contractor in non-dumping gondola cars. Shoveling from such cars by hand is slow and costly. A device used recently at Torrance, Calif., enabled the contractor to remove most of the material from a car at low cost.



The arrangement, as shown by sketch herewith, consisted of a light steel chute arranged to be hung over the end of a car at an elevation such that a wagon could be driven across the track beneath the chute. Inside the car a slip scraper was used to drag the material in the car up to the end of the chute. This reached all but a small amount directly below the end of the chute which had to be removed by hand.

One or two men guided the scraper, which was drawn forward by a cable passing over rollers on the top of the chute to a snatch block located far enough ahead of the car to permit the dump wagons to pass beneath it. A span of animals attached to the fall line dragged the scraper forward, but it was returned to the far end of the car by the scraper men themselves.

*Consulting Engineer, Los Angeles, Calif.

While very simple, the device was entirely successful, requiring only a slight amount of adjustment for successful operation on cars of greatly varying sizes. It was devised by Mr. Grider, of the Bent & Pennybaker Co.

A Concreting Train Using a Drag-Line Excavator

In track elevation work, the making of concrete is done very generally by the use of a train composed of cars of material and a car equipped with a mixer and other apparatus. In most cases, plank runways are laid over the cars, and the stone (or gravel) and sand are conveyed in wheelbarrows to the charging platform of the concrete mixer. This method necessitates the handling and fitting of a number of planks for the runway, and it is said to require an average of 25 wheelmen to handle 150 cu.yd. of concrete material per 10-hr. day.

In 1910, W. B. Louer, of Chicago, conceived the idea of simplifying this work by unloading and conveying the material directly from the cars to the mixer by means of a drag-line bucket. The bucket would be operated on a slack line directly over the material cars, supported at either end of the train by steel towers mounted on flat cars.

The details of this equipment were not worked up until later, but early in 1913, the first plant was sold to the Chicago, Milwaukee & St. Paul Ry. for use on its Bloomingdale Road track-elevation work in Chicago. In perfecting the design of the plant Mr. Louer was assisted by Mr. Page, of the Page Engineering Co. (which supplied the bucket and made the drawings for the steel towers), and by Mr. Middleton, the Engineer of Track Elevation. The plant was used in connection with the portable concreting plant having a folding tower for the elevator bucket as described fully in an article on this track-elevation work in ENGINEERING NEWS of July 3, 1913. The work is under the direction of C. F. Loweth, Chief Engineer of the C., M. & St. P. Ry.

The equipment as used on that work consists of two 45-ft. folding steel towers mounted on flat cars located at opposite ends of the concrete train. Each tower when raised is guyed back by two 1½-in. steel cables anchored to horizontal steel trusses which are attached to the body of the car. These trusses carry hand winches for raising and lowering the tower by means of the cables.

Fig. 1 shows the complete train with its equipment. Fig. 2 shows one of the towers being lowered.

One of these cars is placed immediately behind the concrete mixer, and has storage hoppers so built that the steel tower may be readily folded over these hoppers, and so that a belt conveyor or charging dump-car can be run on a track in the center of the car and underneath the auxiliary hoppers to carry the aggregate to the mixer.

The power car, at the rear end of the train, has the 45-ft. folding tower and a specially built triple-drum 30-hp. hoisting engine with boiler. The front drum of this engine is made strong enough to hold the strain of the main supporting cable. The rear drums are arranged with special brake hands fitted on the flange end to take care of the hard usage. The levers and brakes are brought forward and arranged in a quadrant about 6 ft. above the car floor, so that the engineman may have a good view of all the movements of the drag-bucket.

This plant was designed for five cars of material to be switched in and their contents unloaded into the auxiliary hoppers of the storage-bin car before it is necessary to make a switch of empties. There is a storage capacity of 30 yd. in the auxiliary hoppers, which provides sufficient material for a 1½-yd. mixer to mix one hour. In actual practice it has been demonstrated that the cableway can be taken down, the empty cars switched out, and another train of concrete material switched in, in not to exceed 45 min., so that the concrete mixer can work continuously.

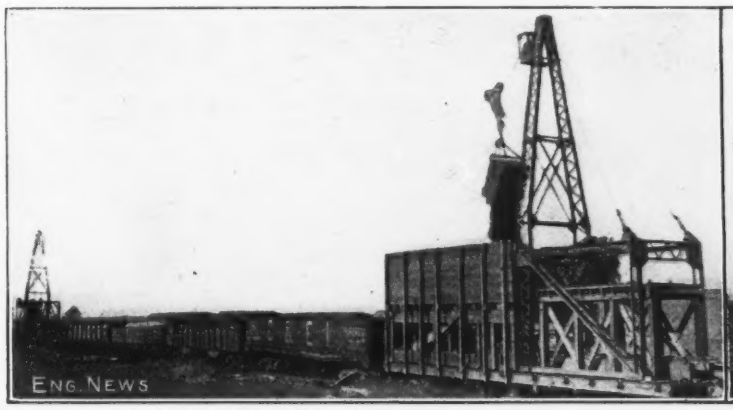


FIG. 1. CONCRETING TRAIN WITH DRAG-LINE BUCKET AND CABLEWAY FOR UNLOADING MATERIAL FROM CARS TO HOPPERS

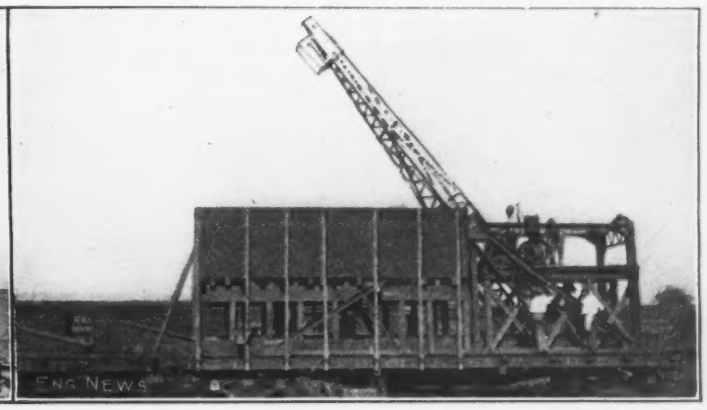


FIG. 2. LOWERING THE PIVOTED STEEL TOWER ON THE HOPPER CAR OF THE CONCRETING TRAIN

On the storage car is a platform about 7 ft. high, on which is mounted a small gasoline hoist (shown in both cuts).

When the five cars of material have been emptied and it is desired to switch these out and put in five loaded cars, the procedure is about as follows: The drag bucket and carrier are hauled in and landed on a platform on the front end of the power car. Then a ½-in. steel cable is run from the gasoline hoist above noted, over the sheave in the top of the steel tower, and is attached to a large hook block on the supporting cable. After this block has been unhooked from the tower, the engineman on the power car winds up the three cables on the engine drums. By means of a hand brake on the gasoline hoist, at the opposite end of the train, just enough tension is kept on the ½-in. line so that the blocks do not drag on the tops of the cars. After the supporting and operating cables of the drag line have been wound upon the drums,

the ½-in. tag line is unhooked from the cable blocks and laid on the ground alongside the empty cars.

If there are trolley wires, telephone wires, or other overhead obstructions, the steel tower on the power car is lowered by unfastening the 1½-in. steel guy cables and then lowering with a hand winch. This is the car shown in Fig. 2, and at the right in Fig. 1.

The work is now ready to switch out the empty cars and set in the five loaded cars. When the latter have been switched in, the tower on the power car is raised, the ½-in. pay line is attached to the drag-line cable blocks, and the gasoline hoist on the storage car then pulls up the block which holds the main supporting cable. As soon as this block is fastened to the top of the storage-car tower by means of a hook, everything is in readiness to begin unloading stone and sand from the cars to the auxiliary storage bin. During this time the work of the concrete mixer has not been interrupted, because there was sufficient material in the storage bin to run the concrete mixer for an hour.

The drag-line equipment, with a 1-yd. bucket, can handle easily 60 cu.yd. of loose material per hour. In fact, the drag-line engineman has been idle about half the time because the 1½-yd. concrete mixer cannot mix concrete as fast as the 1-yd. bucket can deliver material to the mixer.

It was thought at first that the drag-line bucket would damage the bottoms of the cars, but experience has proved that this is not the case. It is necessary, however, to take the wheel off the brake-staff in order to make sure that the bucket does not damage this and render the brakes inoperative. The width of the drag bucket is about 4 ft., and about 75% of the material in the car can be unloaded without assistance. After this it is necessary for two men to get in the car and shovel the remaining material from the sides of the car toward the center. Then the drag bucket will take out this material with the exception of about 3 cu.yd. The drag bucket is then spotted in the car, and the two men shovel the remaining material into it.

The number of men needed to operate this plant is seven in all: An engineman and a fireman on the power car, two laborers to clean up the five material cars, a signal man to warn the engineman to dump the bucket when he has it over the sand and stone hoppers (this man also attends to the gasoline hoist when a switch of cars is being made), and two men under the hoppers on the hopper car to attend to feeding the sand and stone to the mixer.

This equipment is applicable for use with any style or make of concrete mixer. It is a portable plant and can be prepared for movement from one place to another in about 30 min. The entire outfit was furnished by the W. B. Louer Co., Old Colony Bldg., Chicago, to which we are indebted for information.

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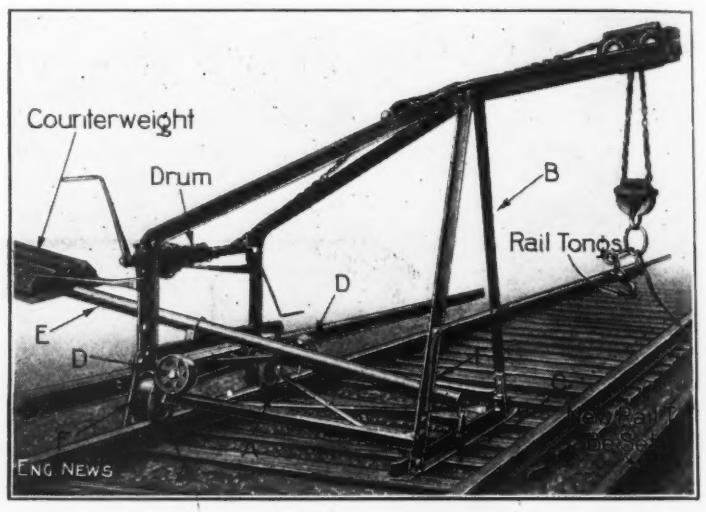
Making Asphalt Pavements Non-Slippery—The Superintendent of Street Repairs of San Francisco, Calif., has hit upon a method of removing the chief objection to asphalt pavement, described in the "Municipal Record," as follows:

The method of rendering the pavement less slippery is by heating the surface of the asphalt and then applying a layer of coarse sand which is rolled into the pavement, which affords a sufficiently rough surface to enable horses to keep their footing and automobiles to pursue a straight course in wet weather. Experiments with this pavement on Fell St., between Baker and Scott, and on Scott St., between Fell and Waller, have proved so satisfactory that the city officials have decided to extend its use to other parts of the city.

A Rail-Handling Machine for Rail Renewals

In renewing rails, the labor problem is often a serious factor, owing to the large number of men required to handle heavy rails and the difficulty of organizing the men for efficient work. A light rail-handling machine for picking up the new rails (distributed along the track by work trains) and setting them in position is now in use and giving very satisfactory results.

The machine, which is shown in the accompanying cut, is a hand crane, having a pair of double-flanged wheels *A* to ride upon one rail while the inclined boom is supported by an A-frame *B* resting on the ties. The sill *C* of this A-frame may be fitted with a pair of pivoted or removable axles carrying small flat-tired wheels to ride on the opposite rail. In the cut these are shown removed and placed temporarily on the frame at *D*. When the machine is to be moved from place to place, or when it is



RAIL-HANDLING MACHINE FOR RAIL RENEWALS
(P. H. Madden, Sparta, Wis., inventor. Franklin Iron Works, La Crosse, Wis., maker.)

to be moved forward and the rail is already in place, these wheels can quickly be replaced.

With the arrangement shown in the cut, the weight is transferred entirely to the one rail by pressing down on the counterweight bar *E*, so as to raise the A-frame clear of the ties. Then the extra wheels can be adjusted, or the machine can be pushed forward while balanced on one rail, by men at the handles *F*. The bar *E* is detachable, and carries a platform for splice bars, etc., to form the necessary counterweight.

The winding drum carries a chain forming a loop in which hangs the hoisting block to which rail tongs are attached, the fixed end of the chain being attached to the head of the boom. The chain is of such length that rails 14 ft. from the track can be reached, but it is only rarely that the rails are at such a distance, if the distribution has been done properly. The machine can be placed on the cars of a work train for loading the old rails, and it can be run to and fro on the track to carry rails, frogs, switches, etc., to the points where they are to be placed.

Only three men are required to operate the machine, two of them being at the crank handles, the third carries out the chain, attaches the tongs, and guides the rail into place. They can readily handle heavy rails, frogs, switches, etc., picking them up from the ground, carrying

them to place and setting them in position. It is stated that three men with the machine can do as much work as an ordinary rail-handling crew of 12 to 20 men, and can easily keep up with the men who are pulling the spikes and doing the work in advance. The three men can lay 100-lb. rails at the rate of three per minute.

In one instance on the Chicago, Milwaukee & St. Paul Ry., two stretches of rail renewal were in progress. The first foreman had a gang of 38 men, and there was only one passenger train to provide for; in a working day he laid 1697 ft. of rail, with Weber joints, and placed two anticreepers on each rail as it was laid. The other foreman had 25 men and a rail-handling machine, and had to take care of five trains. In a working day he laid 1848 ft. of rail, with Bonzano joints, and applied eight anticreepers to each rail. In July, a rail-renewal gang using the machine did rapid work on the La Crosse Division of the same railway. This is a double-track line with heavy traffic, so that it was frequently necessary to interrupt the work and close up the track for the passage of trains. They handled 90-lb. 33-ft. rails, and the work was as follows, the number of men given being exclusive of the three machine-men:

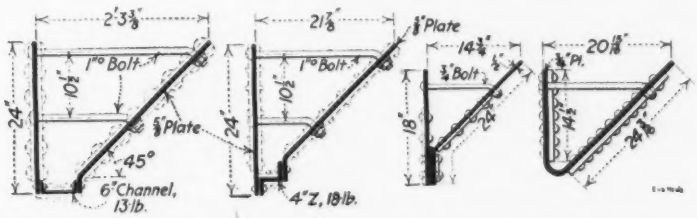
	No. of section men	No. of rails laid
July 17	36	153
July 18	36	157
July 19	36	40*
July 21	40	207
July 22	35	120
July 23	40	212
July 24	44	223
July 25	35	154

* And changed two switches.

The machine is the invention of P. H. Madden, Roadmaster of the Chicago, Milwaukee & St. Paul Ry., at Sparta, Wis., and it is manufactured by the Franklin Iron Works, of La Crosse, Wis. It is used not only on the railway mentioned, but also on the Northern Pacific Ry., and the Great Northern Ry. A machine of the same general character but requiring a larger number of men was described in ENGINEERING NEWS, Jan. 23, 1913.

Steel Cutting-Edges for Concrete Caissons

Reinforced-concrete caissons sunk through rock form the foundation for the main part of the Tennessee River dam at Hales Bar, Tenn. There are 26 caissons in all, in sizes from 30x32 ft. to 54x70 ft.; in sinking them there was opportunity for trying variations in design. Several types of cutting-edge were tried, sketched herewith. It is stated by the engineers in charge of the



FOUR FORMS OF CUTTING EDGE FOR CONCRETE CAISSONS

contract work that the last one sketched, the round cutting-edge, proved greatly superior to the others; this, of course applies to *work in rock* only.

The rock under the cutting-edge was removed mainly by blasting. An important matter was to clear the rock away well outside the outer line of the caisson, as otherwise a projecting point might hang up the caisson. The round-edge style of cutting-edge was the best adapted to this requirement, whereas the flat-bottom styles, especially the first one (6-in. channel base) gave considerable trouble in clearing.

Blasting with light charges was done close to and right under the cutting-edge in all the caissons, but in no case damaged the cutting-edge. The explosive was 60% dynamite.

Diagram for Projecting Edges of Steel Bearing-Plates

In designing the shoe-plate of a column or of a girder, or the masonry-plate under the end of a beam, the thickness of the plate is usually determined by the allowable bending stress in the corbeled-out plate—the bearing pressure being assumed equal to the allowed base pressure.

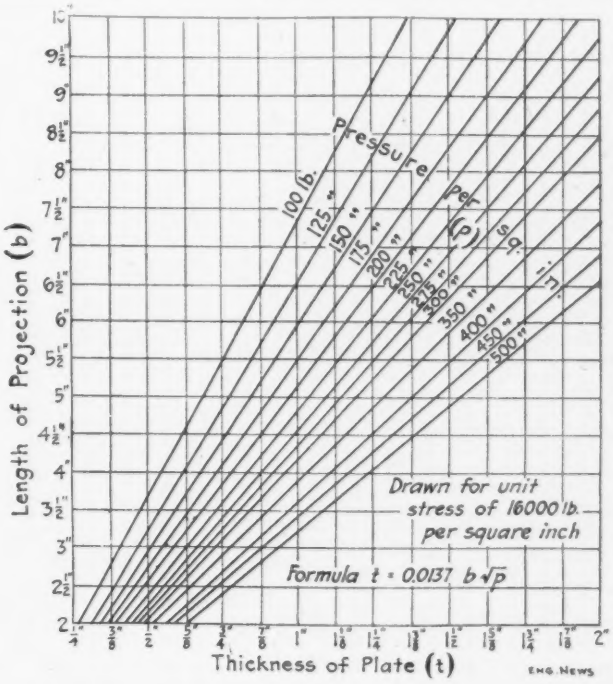


DIAGRAM FOR PROJECTING EDGES OF STEEL BEARING-PLATES

Devised by J. H. H. Poole, Baltimore, Md.

(For plates up to 2 in. thick, and projections up to 10 in.)

The calculation is not difficult. If p is the allowed base pressure (lb. per sq.in.), b the amount of projection (in in.), f the allowed bending stress in the plate, and t the required thickness of plate,

$$M = \tfrac{1}{2} p b^2 = \frac{f t^2}{6}$$

per inch of width, or

$$t = b \sqrt{\frac{3p}{f}}$$

If f is taken as 16,000 lb. per sq.in.,

$$t = 0.0137\, b \sqrt{p}$$

from which either the thickness, overhang or bearing pressure may be found when the other two are given.

The diagram herewith solves this formula. It avoids curves by utilizing the straight-line relation between t and b, and showing a different line for each value of p.

The diagram was drawn by J. H. H. Poole, structural engineer, P. O. Box 615, Baltimore, Md.

A Cableway with Side-Swinging Towers

A novel departure in construction cableways was made by A. Bleichert & Co., of Leipzig, Germany, in connection with the construction of Lock No. 1 of the Rhine-Herne Canal, Germany. In this case it was inconvenient to use transverse cableways traveling along the longitudinal sides of the lock excavation, and longitudinal cableways seemed to be dictated by the local conditions. To arrange these as traveling cableways would have been rather expensive, considering the small length of travel. It was proposed to use two cableways, one over each longitudinal lock wall, and to get lateral reach by using a laterally swinging mast as end support of the cableway. This scheme was adopted. The mast is arranged to swing laterally on its base as a pivot under control of two side guys connected to hoisting engines.

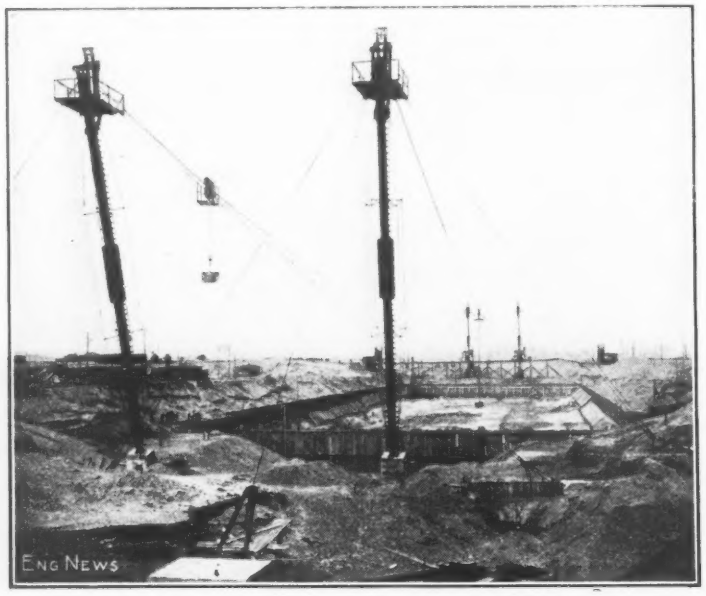


FIG. 1. GENERAL VIEW OF LONGITUDINAL CABLEWAYS OVER PIT FOR CONSTRUCTION OF LOCK 1, RHINE-HERNE CANAL, GERMANY

The two views herewith illustrate the arrangement of the cranes and how they were placed with respect to the work. The two double side guys of each cableway mast can be seen in the views. In Fig. 2 the engine-houses for the two cableways are seen at the extreme right and left. The operating ropes lead from the foot of each mast to the corresponding engine house. Excavation spoil is handled by the cableways to the hoppers over the narrow-gage track on a trestle in front of the mast, Fig. 2; a similar equipment was used later for handling in the concrete material.

These slewing cableways are said to have handled their work just as efficiently as traveling cableways, at a much lower construction cost.

NOTES

Cutting a Concrete Wall to provide expansion joints is a problem now faced by a contractor, who asks for information. The wall is 16 in. thick (presumably with steel reinforcement) and the slots should be of such section as to retain the asphalt filler. Air drills and air chisels have been suggested, but at present the problem is unsolved. Perhaps some of our readers can give suggestions or experience as to work of this kind.

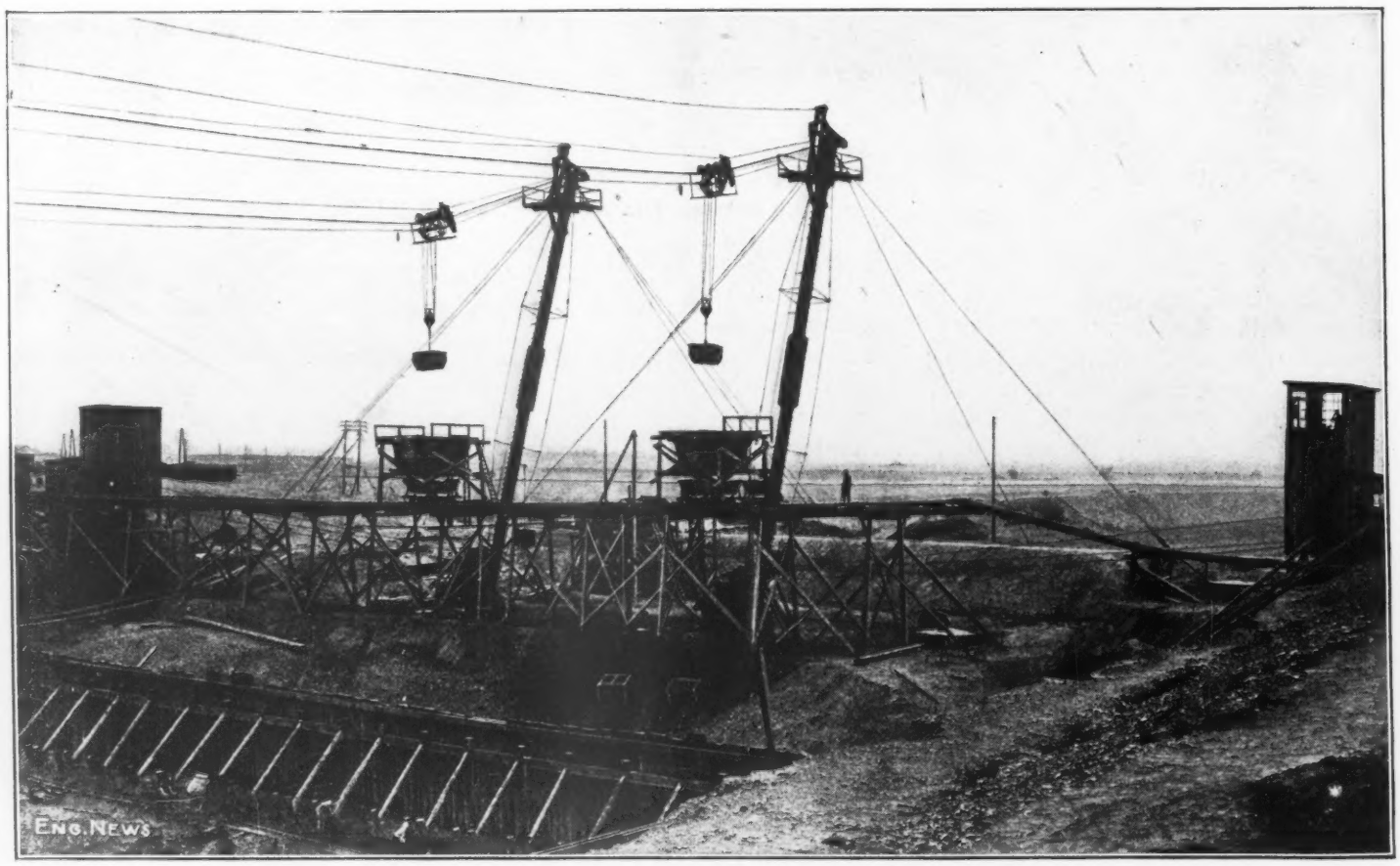
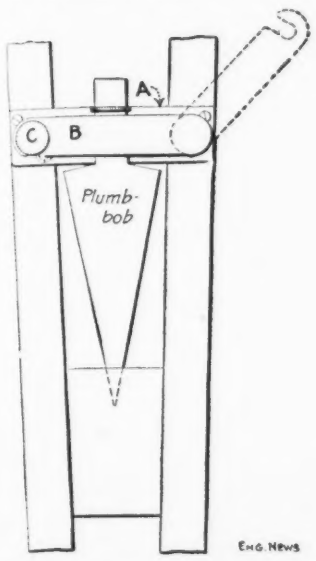


FIG. 2. SWINGING MASTS AT OPERATING END OF CABLEWAYS
(Operator's houses at left and right.)

Plumb-Bob Holder—A plumb-bob holder attached to one leg of the transit tripod has been designed by a Canadian surveyor, as a remedy for the plumb-bob getting lost or punching holes in the transitman's pockets. The cut shows the device applied to a split-leg tripod. The point of the plumb-bob rests in a ¼-in. hole bored ½ in. deep in the spacing block of the leg, while its neck fits between two strips of brass. The inner strip, A, is secured by two screws. The outer strip B is hinged at one end, while the other end is notched to hook over a pin C. This pin is fitted as a clamp screw, so that by a slight turn of the milled head the plate is held firmly in place. Both plates are slightly bent at the middle so as to allow for the neck of the plumb-bob and the string which is wound around it.



PLUMB-BOB HOLDER ON THE LEG OF A TRIPOD

This contrivance is described in the 1913 "Proceedings" of the Dominion Land Surveyors Association, by F. H. Kitto, Director of Surveys, Dawson, Yukon Territory, Canada. He states that he uses this as the permanent receptacle for the plumb-bob, whether in the field or the office.

Easement Curves for Street-Railway Track—For street-railway curves, where (as in streets) the external secant governs the layout more rigidly than in other railway work, K. P. Armstrong (Boston, Mass.) proposes using easement curves of double the main-curve radius, and running the central curve to tangents offset inward by an amount arbitrarily assumed. The procedure as he recommends it would be: Knowing the external secant of the entire curve (from the physical conditions), the amount by which the intersection point is shifted inward must be assumed first of all, to give sufficient length of easement curve without reducing the main-curve radius too much. Then the offset tangents and their P.T.'s are located, and the central curve run from them; finally the easement curves are set by offsets.

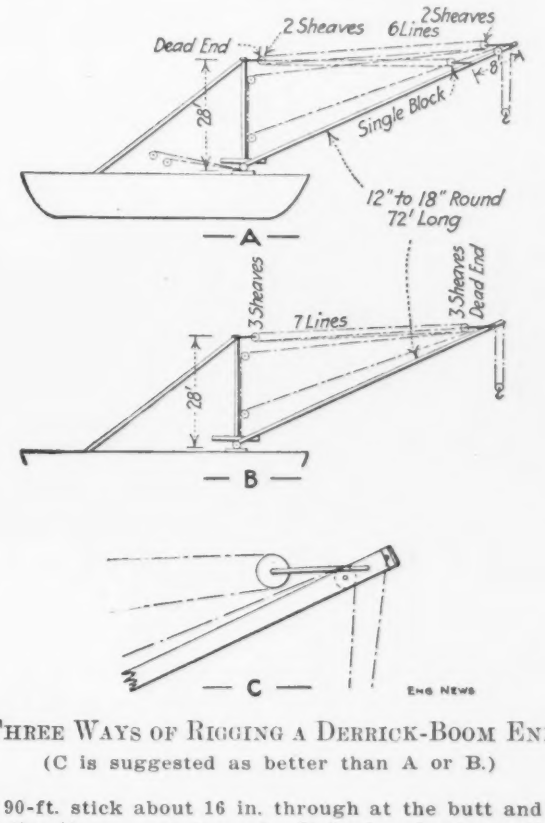
The general method proposed is very old. On its special value for street-railway work the opinions of others would be useful.

A Simple Power Scraper Outfit was used for earth stripping at the limestone quarry of a lime-manufacturing concern at Middlebury, Vt. A description was given by J. A. Peck at the National Lime Manufacturers' Association meeting last month.

The outfit was made up of a double-drum hoisting engine, a wire rope, a few 24-in. sheaves, and several 15-ft. wheeled scrapers. There was also a heavy contractor's plow, for use in place of the scrapers to break up the ground where the digging was too hard. The tongues of the scrapers were cut off to 8 ft., and a small wheel set under the stub to hold the tongue off the ground. One scraper was hitched to the end of a wire rope running through a sheave beyond the dumping-ground and thence to one drum of the hoisting engine. Back of this scraper were hitched the others, in tandem, with 6-8-ft. spacing between; the scrapers were connected by a pair of ropes leading from the tongue of one scraper to the sides of the scraper next ahead. The rear of the rear scraper was hitched to a bridle on the end of a rope leading back through a sheave located back of the site to be excavated, and thence to the second drum of the hoister. By hauling in on one drum and paying out on the other, the scrapers would be pulled forward from the stripping site to the dumping-ground, and by the reverse operation they were hauled back. Five or six men were used; two loading the scrapers, two dumping them and leveling the dump, and the rest to handle the hoisting engine. In operation, first the front scraper was filled, and the others in turn, whereupon the train is hauled forward, dumped and hauled back.

This plant was used only a few weeks, due to local conditions, and it did not work steadily because the boiler of the hoisting engine was defective. Yet the experience was enough to prove the power scraping to be much cheaper and quicker than horse scraping.

Three Derrick-Boom Ends—In the sketch below, A and B show two scow-derricks working side by side at the quarry of the International Contract Co., near Seattle. They are handling loads up to 5 tons. Except for the rigging they are alike in all respects. Derrick B shows much less vibration of the boom under load than A. The reason for carrying two parts of the boom line of A to a sheave set back along the boom some distance from the end is to get the resultant of the pulls back of the load line. In B the same effect is secured by attaching the boom-end block to the pin of the hoist-line sheave, so that the bucket end of the hoist line gives a slight cantilever action that tends to balance the weight of the boom. A boom broke recently, which had its main boom-falls sheave fastened to the end of the boom, as in A, but did not have a sheave back on the boom, the dead end of the line being fastened near the end of the boom. This



THREE WAYS OF RIGGING A DERRICK-BOOM END
(C is suggested as better than A or B.)

was a 90-ft. stick about 16 in. through at the butt and 10 in. at the tip; it was not trussed. It broke about one-third of its length back from the end.

An arrangement like C in the sketch suggests itself as more satisfactory than A or B. This is, of course, commonly used, but it ought to avoid the difficulties occurring in both A and B. [W. J. Ryan, Waterman, Wash.]

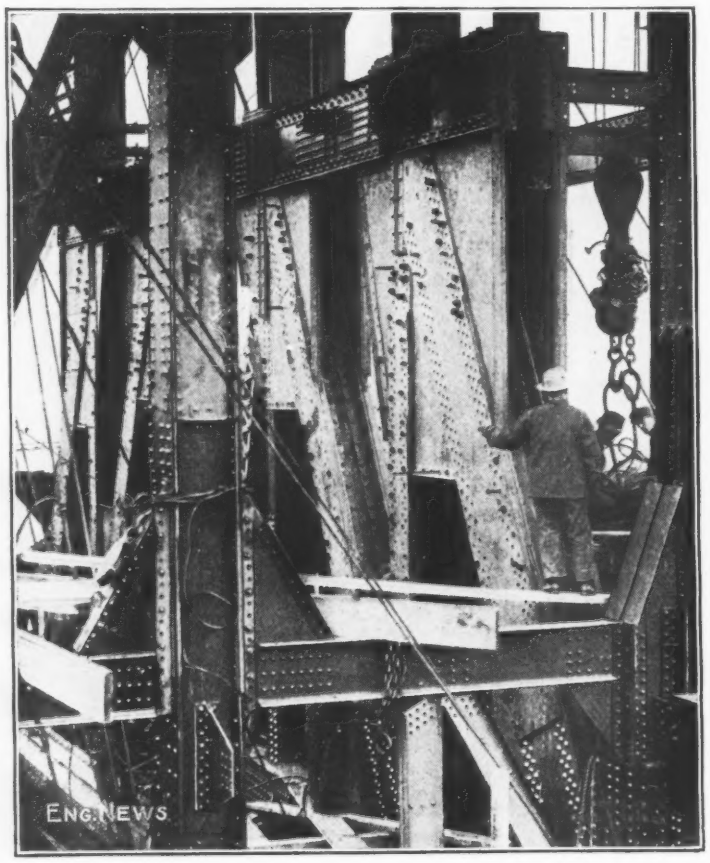
Tests on the Strength of Adobe Brick were made some years ago by Herbert N. Alleman (now a resident of South America), assisted by W. F. Schaphorst, the latter of New York City, but at that time resident in the Rio Grande Valley. As is well known, adobe is the alluvial clay of southwestern United States and Mexico, which is formed into brick (usually 9x12x4 in. in size) and allowed to be sun dried. Mexican brickmakers generally add chaff or some other fiber substance for binding together the mixture. The ingredients are mixed without the aid of machinery. Peons tread in the wet mixture barefooted until the proper consistency for molding has been reached. When dry, adobe has the appearance of an ordinary chunk of dry gray mud, but it will give a metallic ring when struck, similar to the ring of ordinary burned-clay brick.

The tests were made in tension on briquettes of 1-in. section, of the standard cement-testing type; in compression on 1 in. square by 5 in. long prisms (in compression along the 5x1-in. surface); and in flexure on 1-in. square pieces over a span of about 4 in. The average tensile value of the briquettes was found to be about 60 lb. per sq.in., few falling below that figure and some attaining a tension as high as 80 lb. per sq.in. The compression specimens ran up to about 500 lb. per sq.in. on the average, with not very great variation. The flexure specimens broke uniformly in tension with an extreme-fiber stress value of about 60 lb. per sq.in. All specimens were carefully made and were undoubtedly of considerably greater strength than would be attained by the materials commonly used and mixed in the usual way.

Attempts were made to reinforce the adobe beams with steel in a manner similar to the reinforcing of concrete, but it was discovered that adobe shrinks considerably while drying so that large cracks appeared all along the beam and reinforcement proved a failure. It was then suggested that a small percentage of cement might be added to the adobe to reduce the shrinkage. This was somewhat successful, but not sufficiently to be of any value. Cement did not improve the strength quality of the adobe until a half-and-half mixture was used.

In the opinion of Mr. Schaphorst, who reports these tests, there would be a field for a building-block machine to manufacture adobe blocks. He believes machine-made blocks would be stronger, more durable, and would require less mortar because of the truer form of block that could be produced. The cost of adobe buildings with the more expensive mortar joints would be correspondingly reduced. So far as our correspondent knows, however, there is no machine made for this purpose.

A Large Building Truss is illustrated in the halftone herewith, from the new U. S. Custom House, Boston, Mass. It goes through two stories, and weighs about 100 tons. [C. T. Thoner, Boston.]



TRUSS IN U. S. CUSTOM HOUSE, BOSTON

Loading Formulas for Crane-Girders—The formulas for loading on crane girders given by E. Owen (Oct. 23, p. 815) contained a serious printer's error. The wheel-load of the crane is

$$W = 5.1 + \frac{C}{0.85 - 0.0035\,S}$$

where

C = Capacity of crane, tons
S = Span of crane, ft.
W = Wheel-load, 1000-lb. units.

The second term in the denominator was erroneously given as 0.0935.

Application of the formula: A 20-ton crane 65 ft. in span has a wheel-load

$$W = 5.1 + \frac{20}{0.85 - 0.0035 \times 65} = 37.3 \text{ (37,300 lb.)}$$

By the second formula given, the wheel-spacing of this crane is

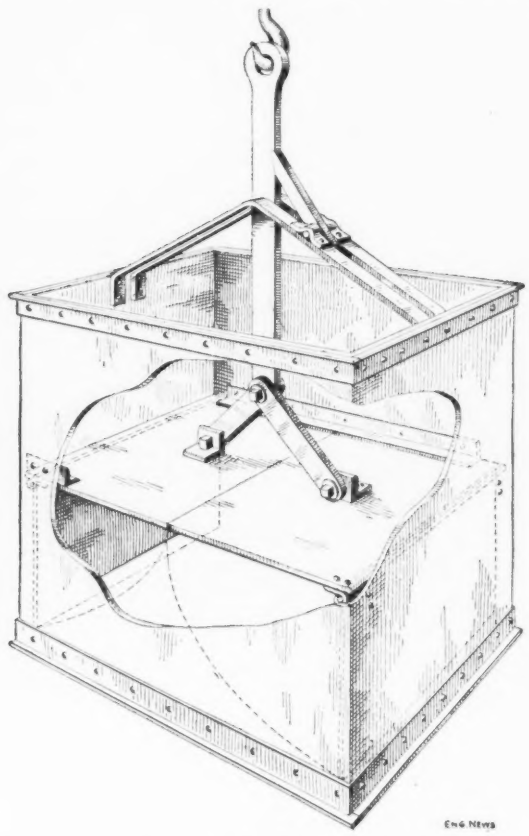
$$D = 7 + \tfrac{1}{10}\,C + \tfrac{1}{40}\,S$$
$$= 7 + \tfrac{1}{10}\,20 + \tfrac{1}{40}\,65 = 10.6 \text{ ft.}$$

Concrete Walls Made of Cement Grout into which are dropped rough field stones, are being used in the construction of buildings on the country estate of J. P. Thomas at Middleburg, Va. The plans of the houses were prepared by F. J. Sterner, a New York architect, and the forms of J. D. Morrill are being employed on the work. These steel forms are first placed for the houses, coated on the inside with rosin and sand to give a rough face, and then filled in with a liquid grout of cement, lime and sand. Into this grout rough field stones of all sizes and shapes are dropped and bedded. After this has set up, the forms are removed and a thin coat of cement stucco plastered onto the prepared face. It is reported that this grout construction has been used on over 1000 cu.yd. of 12-in. wall.

With common labor at 19½ cents per hour, the cost per cubic yard was:

1 yd. field stone	$0.60
¾ yd. sand at $1.50	1.12
300 lb. cement at $1.50 a bbl.	1.12
100 lb. lime	0.48
Forms, setting and pouring	0.89
Total cost	$4.21

An Improvised Bottom Dump Concrete Bucket has been used quite extensively by the engineering force of a western railway. The bucket is made in the shops of the railway for use in depositing concrete under water. The accompanying sketch shows the general details. It consists of a square section bucket made of wrought-iron plates, braced at top and bottom with angle irons, and having part way up the inside a double door hinged on each of two opposite sides and dropping down against those sides in the manner shown. These doors are connected by a toggle joint to a vertically



disposed bar from the top of which the bucket is hung from the derrick line. Hinged to the top supports of the bucket (which supports can also be used in lifting the bucket) is a dog which can engage a notch in the suspension bar.

In operation the bottom dumping doors are held closed against angles riveted to the sides of the bucket by the tension of the toggle due to the weight of the bucket hanging from the derrick. To keep the doors closed when the bucket is not suspended, the dog is swung into the prepared notch. In depositing concrete the bucket is filled to its top level and swung into the water at the place where deposition is desired. When it reaches bottom the tension on the line is relaxed and the bottom doors drop alongside the sides of the bucket and the concrete slips down into the opening, the doors automatically shutting when the bucket is raised. If it is desired to rest the bucket on some other surface before lowering to the bottom the dog is slipped into place, and the line can then be slacked off without causing the doors to open.

EDITORIALS

Advertising an "Institute of Efficiency"

Is efficiency a fraud? We hesitate to say, yes; but we do not hesitate to say that the methods used by some of the apostles of efficiency for its promotion are calculated to discredit the whole efficiency movement.

A correspondent sends us an advertisement by one of these apostles stating that "the whole story" of this apostle's "Method of Efficiency has been condensed into 24 lessons so that you can acquire an Efficiency Education without leaving your home or giving up your present occupation."

Young Mr. Easy Mark who reads this flaring advertisement is further assured that of the scores of men previously trained by the said apostle, all are now drawing high salaries, one of them $2000 a month and that this course of 24 lessons *is a short cut to business success.*

It is further stated in large display type that "almost everybody needs this course and almost everybody can afford it." Not a word is said as to previous education or inherent ability being necessary for success in such work, and the fair inference is that anybody, young or old, no matter how limited his knowledge and experience, no matter how deficient he may be in mental or moral qualities, can take this course of 24 lessons and be placed on the high road to the success represented by a $2000 a month salary.

It seems to us a fair and moderate statement that such advertising is properly to be classed with Julian Hawthorne's circulars of the King Solomon Mines, or with those of the so called educational institutions which claim to teach law or medicine and award diplomas and academic degrees for a few weeks or months of study.

We respect the achievements of a few able and reputable engineers who, after laying a sure foundation by long and successful professional and business experience, have undertaken special work as professional advisers to concerns who seek to improve their business methods.

But the swarm of half-baked "efficiency experts" who are seeking employment as "business doctors" on the strength of a correspondence course in some "Institute of Efficiency" or solely on their claims to expert knowledge and who ought not be trusted to doctor a cat—such men as these are rapidly discrediting the whole efficiency movement in the minds of intelligent business men.

Two clauses of the Code of Ethics, just sent out for letter ballot by the American Society of Mechanical Engineers, read as follows:

> (20) The engineer should endeavor to assist the public to a fair and correct general understanding of engineering matters, to extend the general knowledge of engineering, and to discourage the appearance of untrue, unfair or exaggerated statements on engineering subjects in the press or elsewhere, especially if these statements may lead to, or are made for the purpose of, inducing the public to participate in unworthy enterprises.
>
> (24) Engineers engaged in private practice should limit their advertising to professional cards and modest signs in conformity with the practice of other professions.

We believe that all engineers who value their professional reputation will recognize the wisdom of the above rules, and will agree that any engineer who violates them brings discredit not only upon himself but upon the profession.

Dry Weather Levee Failures

Sloughing off of levees during periods of flood is a well known form of failure and is commonly guarded against by banquettes on the land side and other methods to prevent the river water from seeping through or eroding the bank. At such times, of course, the failure of the levee results in an inundation and a large loss of property; yet the damage to the levee itself is no more than may happen at a time when flood protection is far from being a present problem—when the river is at its lowest stage.

Water may seep through from the land side as well as from the river side; and in an earth embankment seepage water is a dangerous element in whichever direction its flow occurs. Seepage water from behind the levee when the river was at an extraordinarily low stage—and a poor foundation—is responsible for one of the worst levee failures which has occurred recently in the Mississippi River Valley.

The sloughing off of 1,500,000 cu.yd. of earth from the levee protecting the lower part of the City of Helena, Ark., is described, together with a brief history of this levee, elsewhere in this issue. The slough occurred during the dry-weather period when the river was at about a 4-ft. stage. It was the fourth large slide which had occurred at this point under exactly similar conditions; and it means a loss to the city of about half a million dollars.

The problem here has been to maintain an earth embankment 50 ft. high, practically on the river bank, on a foundation of impervious hard brown clay overlaid with a stratum of quicksand, which outcrops in the river about 200 ft. from the river bank. After the first slide, the most troublesome part of the river bank was revetted with woven and fascine mattresses, with the idea of covering the sand outcrop in the river bed. Other slides and cave-ins followed, and seepage water was found in the levee. It was attempted to get rid of this by drainage on the face and behind the levee. Now the worst slide of all has developed and it has been decided, we believe, to build a levee somewhere in the rear of the present location. Neither the revetment nor the drainage scheme was ever fully carried out to the satisfaction of the government engineers, owing to the lack of necessary appropriations.

Fortunately, periods of extreme high water do not follow immediately upon periods of low water, so that in all probability the levee will be repaired before another flood is imminent. Fortunately, also, similar foundation conditions do not exist commonly in the Mississippi Valley; yet this form of failure and the ever-present

danger to levees similarly situated at times of extreme low water is a point worth bringing to the attention of engineers engaged in levee construction work. Apparently, there is no tried and satisfactory method of preventing such failures, at reasonable cost, and few engineers will care to trust wholly to luck when known conditions, unprovided for, may cause repetitions of failures to the same structure.

A Fairly Good Fee for an Engineer

Engineers who have become discouraged at the lack of financial recognition of the engineering profession, should take heart after reading the final paragraph in the article in this issue describing the proposed new water-supply for Ottawa, Canada. In that paragraph they will see that the City Council of the capital city of Canada has just voted to retain Sir Alexander R. Binnie, the well known English engineer, as the designing and supervising engineer for the new water-supply system; and that it has accepted Sir Alexander's proposition that he be paid $100,000 for the complete supervision of the scheme from its design through the completion of its construction, the engineer to furnish for this sum all of the engineering supervision and inspection, as well as the designing, specification writing, and advice ordinarily given by a consulting engineer.

Specifically, Sir Alexander Binnie agrees to furnish the entire engineering force for the survey of the line, the designing of the system, and the supervision of the work during construction. He agrees to prepare the necessary contract drawings and to supply all the necessary specifications and bills of quantities; he agrees further to be responsible (although such responsibility is, of course, not financial) for the proper execution of the work and for all payments made to the contractors, and he guarantees that at least twice during each working season he himself or one of his partners will come from England and visit the work. In other words, the English engineer will substitute his own office and force for the ordinary city department which has control of the construction of a new water-works for a city, such an organization, for instance, as the New York Board of Water Supply.

This, it will be seen, is an extraordinary contract. It is of a type fairly common, we believe, in those out of the way countries where local authority is not sufficient to undertake the establishment of its own engineering force, but decidedly unique in a civilized, modern city of the size and quality of Ottawa. Realizing this, Sir Alexander submitted an alternative proposal whereby the city furnished the engineering force and the English engineer the services of his consulting firm. For this he was to receive $140,000. The city fathers, however, accepted the first proposal, under which—using the figures given in a report in an Ottawa paper purporting to come from Sir Alexander himself—the actual cost to the firm will be $300,000, leaving a handsome personal fee to the consulting engineer of $100,000.

As shown in the itemized estimates on p. 1013 of this issue, the total cost of the new system will be $8,000,000, and the Mayor of Ottawa in recommending the acceptance of Sir Alexander's proposition, ingenuously remarked that the fee requested was on the usual basis of 5% of cost. But examine more closely the items of the estimated cost; $5,500,000 is devoted to a gravity flow steel pipe line, on which the cost of supervision and design is of course comparatively small; $500,000 is devoted to land purchase, on which the engineers have little work to do; and $976,000 is put down for "engineering and contingencies," from which, incidentally, it will be seen that the city will have well over $500,000 to spend on engineering, in addition to that which it pays to its English consultant. This leaves only slightly over $1,000,000 to be expended on construction of a sort that requires any considerable amount of high-class engineering work.

A 5% fee for the design and supervision of construction of a five million dollar steel pipe line is fairly good pay, as engineering pay goes, but what shall be said of a fee of $75,000 for the privilege of drawing a million dollars for "engineering and contingencies" and of allowing a lawyer, properly paid on his own account, to buy $500,000 worth of land?

The Foundation Difficulties at Hales Bar Dam

In view of the opening of the great Hales Bar dam and power development—which occurred last week almost at the time of the appearance of our article describing the difficulties met in constructing the dam—it is worth while calling renewed attention to the quite exceptional nature of the work. In the first place the use of caissons as a dam foundation is new.* In the second place, wherever caissons have been used heretofore they served to *reach* rock, while at Hales Bar they were used to penetrate rock. But the word "rock" here may be misunderstood: the material through which the caissons passed was indeed rock *in situ,* but on the score of physical condition it should be called a boulder deposit, so extensive was the fissuring and disintegration which had resulted from water solution. Moreover, this bed of boulders was full of artesian water streams, which poured forth where the fissures were laid open by the progress of excavation. Under these circumstances the caissons performed nearly the same service as in going down through water-bearing sand.

The Hales Bar foundation caissons may be regarded also as forming a water cutoff under the dam. In this connection the artesian flow as well as the possible (present or future) river-water flow through the fissured strata must be considered. And this cutoff structure at the same time forms a substantial anchorage against the downstream thrust of the water impounded by the dam.

Since the peculiar conditions of the case made the caisson method thus indispensable, it is surprising to learn that the literalness of the government engineers in interpreting the specifications should have delayed its adoption by withholding sanction of the caisson method for more than a month. To hold that when foundations are to be secured in the open they must be laid bare to the light of day under atmospheric pressure is rather extreme. The same objections will probably not be raised in a second case of similar physical difficulties, in view of the success of the Hales Bar work. For this rea-

*For the use of caissons in dam construction, reference may be made to the foundation of the Hauser Lake Dam ("Engineering News," June 22, 1911, p. 743); to the more recent construction of a dam across the Rhine at Lauffenburg, and to the work on the Scotia dam of the New York Barge Canal, now in progress.

son it is good that the question was fought out in an enterprise backed with so much financial courage.

Our description of the work in our last issue made no reference to the financial part of the enterprise. The late Anthony N. Brady was the man who stood back of the undertaking. Special appreciation is due his persistency in continuing the work in the face of expenditure multiplying indefinitely, and in spite of what would ordinarily be a fatal discouragement, namely, the successive failures of three contracting firms to make headway against the difficulties. We have no precise figures on the cost of the work, but when it is stated that the amount of excavation was about 5½ times as great as that originally provided for in the design and contract, and that the underwater rock excavation was multiplied perhaps ten or fifteen times over the contract quantities, some idea can be formed of the enormous total cost.

The Future of the Motor Omnibus

For nearly twenty years it has been accepted as an established fact that the electric street railway represented the final step in the evolution of city passenger transportation. In practically every American city and town of any size, street-railway tracks have been run over every route offering sufficient traffic to make the line a paying one; and on a good many lines where profitable operation will be a matter of the remote future.

In England, however, no such complete victory of the electric street railway over older methods of transport has taken place, largely because of legal obstacles to the use of the city streets by railway lines. Electric-railway development has thus been held back there while the public has continued to patronize the old horse-drawn omnibuses. Within the past five years, however, the motor omnibus has very rapidly supplanted the horse-drawn vehicle; and the mechanical improvements in this type of motor vehicle have been so rapid that it is now recognized as a very serious competitor of the street railway.

In both England and the United States, the last two years have seen an enormous increase in the use of automobile omnibuses and coaches for passenger transport in country districts. Enough success has certainly been achieved both here and abroad so that the motor omnibus must now be recognized as a method of passenger transportation destined to find a very large field of usefulness.

Elsewhere in this issue we publish the first part of the most important paper on the motor omnibus that has at any time appeared. It is an official report, made to the Board of Estimate of New York City, summarizing an investigation made very recently by an expert engineer of motor-bus operation in Paris and London. We urge our readers interested in any way in this subject to carefully study this report. Its bearing upon the economic and financial situation of city and suburban-street railways and upon the whole problem of passenger transportation is extremely important.

It will, of course, be recognized that the final test regarding the success of this method of transport is the economic test. It seems to be well established that the motor omnibuses now running in London are being operated at a cost of not more than 14 to 17c. per mile run. This is certainly an astonishingly low figure. Many American engineers, who have achieved enough prosperity to have their own motor cars, and who have figured their expenditure on them in terms of cents per mile will wonder how it can be possible to operate a London motor bus, carrying thirty or more passengers, for 14c. a mile when their own outlay in running an ordinary touring car amounts to 20 to 50c. per mile or more.

The chief cause of the great contrast in cost of motor-bus operation between America and England is, of course, the great disparity in labor prices. The line of motor omnibuses now operated in New York City shows a total operating cost of over 41c. a ton-mile, or almost three times the figure for the lowest cost London busses. A similar contrast would be found, of course, were we to compare the wages of locomotive-engineer runners in England and in the United States, or of the chauffeurs employed by private individuals.

It is probable, however, that some allowance must be made also for the difference in construction of the American and foreign vehicles, in accounting for the difference in operating costs. As shown by the report above referred to, the weight of the London busses is restricted to about 5500 lb. with a carrying capacity of six tons. This means a very light dead weight in proportion to the load, which tends, of course, to reduce the operating cost. The problems of vehicle body and motor design also appear to have been worked out particularly well, so that the result is a vehicle which gives excellent satisfaction to the public.

It is particularly noteworthy that the cost of repairs is remarkably low on these London busses. Figures before us, giving the average running costs of a fleet of Tilling-Stevens petrol electric omnibuses, run in London for nine months to Sept. 25, 1912, show an average cost for maintenance and repairs, exclusive of tires, of only ½c. per bus mile. The cost for tires was slightly over 2c. per bus mile. As most automobile owners know by dear experience, the most serious item in running a motor is often the repair bill. The figures for the London machines doubtless represent not merely good design and good workmanship, but an excellent organization for taking care of repairs.

A question in connection with the operation of motor omnibuses which interests a very large number of engineers is the effect of the vehicles on roadways and streets. It has been commonly argued that one reason why the automobile omnibus is an unfair competitor of the street railway, is that the omnibus runs on the street pavement, which is maintained by general taxation, while the street-railway car runs on a line of rails which the street-railway company has to maintain.

It is thoroughly established, by experience both here and abroad, that for economic operation of either a motor omnibus or a motor truck, a reasonably good road is essential. It is also fully established that on any type of macadam pavement the wear and tear of a heavy motor omnibus or motor truck is a very serious matter. On city streets, however, with first-class pavements of stone block, asphalt, brick, or wood block, with good foundations, the wear of the pavement by the motor omnibus appears to be no more serious than by any other vehicle. Indeed, it is probably less than the wear caused by heavy steel-tired, horse-drawn trucks.

There is also something to be said in favor of the motor omnibus for city streets as compared with the electric railway, in that the obstruction of the street by rails in

the pavement is avoided, and the full width of the street is available for traffic.

The most attractive feature of the motor omnibus, however, is the comparatively small investment required to establish it in operation. Electric street railways, on the other hand, with the increasing weight of cars and corresponding increased weight of rails, ties and track appurtenances have increased rapidly in cost during the past dozen years. We have traveled a long road since the days, still within the memory of men not yet old, of the oldtime horsecar, jolting cheerfully along on a couple of light strap rails, supported on little timber stringers and with the space between the rails covered with cobblestones or perhaps not even paved at all.

The horsecar promoters of 30 and 40 years ago required very little real money to build the roads which they projected, and could afford to distribute graft liberally to the city councils and aldermen of that day. The early electric railway promoters, too, in the days of double-reduction motors, placed on cars hardly heavier than the old horsecars, and running on light rails, with precious little attention paid to feeders and return current, were able to build electric railways at a cost which seems absurdly small, measured by present-day ideas.

When we face the problem, however, of building a street-railway track which will carry modern heavy, high-power cars, with perhaps interurban cars as well, and the problem of maintaining joints, keeping the tracks in line and surface under various weather conditions, maintaining paving, providing bonds, feeder wires, return mains, permanent pole lines, and the necessary electrical equipment for generation and distribution—when all these things have been provided for, we find that to build a first-class, uptodate electric street railway costs nowadays $30,000 to $60,000 per mile. And further, the annual maintenance and depreciation on such a road is a considerable figure.

In contrast with the large fixed investment necessary for the electric railway is the fact that the motor omnibus requires no investment whatever in the city streets, and the investment in rolling stock is probably little greater than the cost per passenger for an equal capacity in electric cars. This enormously reduces the risk in connection with the investment in a motor-omnibus line. If the venture proves disappointing and the expected traffic does not materialize, the omnibuses can be put in use somewhere else or sold.

The flexibility of routes is another most important advantage of the motor omnibus. In every city there are streets on which the traffic is heavy at certain hours of the day and very light at others. There are roads leading to places which attract a great deal of travel in the summer time, for example, or perhaps in the winter season. A fleet of motor omnibuses can be run just where the passenger travel demand is greatest at any particular hour of the day or season of the year. This flexibility of route is extremely important in the case of street accidents or blockades. How often does it happen that a fire or a street excavation or a broken-down vehicle will stall a long line of electric cars and upset the schedules and service for hours over a large system. With motor omnibuses such interruptions are entirely avoided as the vehicles can make a detour around any obstruction with practically no delay.

Let us not overlook either the great advantage of a system in which every operating unit is independent instead of being tied to a central power station. Notwithstanding all the perfection reached in central-station equipment and operation and in modern electric-distribution systems, it still happens more or less frequently that some powerhouse accident or some breakdown in the distribution system will tie up a whole line, or perhaps a whole system, often for only a few minutes, but sometimes for hours or even days.

It may be said, of course, that this last consideration is offset by the liabilities to breakdowns of the motor omnibus. In fact, half a dozen years ago the idea would almost have been scoffed at in this country that the automobile would become a machine so reliable and certain that it would be a serious competitor of the street railway for urban transportation. That this has actually come to pass, however, there is no room for doubt, and, further, the continual advancement being made in motor vehicles indicates that this competition is likely to grow more and more important as time goes on.

There is even reason to believe that it may have a serious effect upon the stability and safety of investments in electric-railway securities. The public we may be sure will be inclined to welcome with open arms any competitor of existing electric street railways which offers reasonably good service at moderate cost. The American public has so long endured at the hands of the street railway managers the evils of overcrowded, dirty, ill-ventilated cars, with flat wheels and poor equipment of every sort that it will welcome the opportunity to ride in any other vehicle which offers at least as good accommodation.

One of the most notable features in connection with this new development in passenger transportation is the opportunity it offers for the man of moderate capital to engage in the business. The London motor busses are said to cost only about $2500 apiece. In view of the achievements of American automobile manufacturers in producing low-priced motor cars which are unsurpassed anywhere in the world, it is reasonable to believe that at least as good vehicles as the London motor busses and at no higher price ought eventually to be purchasable here. A fleet of twenty such vehicles would represent an investment of only $50,000; and such an equipment kept running on well planned routes in the streets of a small city could furnish the most serious kind of competition to a local street railway company burdened with the fixed charges on perhaps a million dollars or more of capital.

Of course, franchises will be necessary for the operation of such omnibus lines, but they would doubtless be easy to obtain compared with those required for a street railway occupying the street with its tracks. As no fixed investment is required, moreover, such franchises may be reasonably made and accepted for a comparatively short term of years.

Of course, one embarking on such an enterprise must run the risk that someone else may play the same game and start a rival bus line. A street-railway company, for example, might enter upon such a scheme as a matter of defense and cut fares to the lowest point. The loss to the original promoter, however, even if he is beaten, is not at all so serious as in the case of a street railway, since his only investment is in the omnibuses and he can sell them or start a line in some other city.

Further than this, as is well pointed out in Mr. McCollum's report, where city governments are wisely adminis-

tered, free competition in city transportation would not be encouraged or permitted. To allow rival bus lines to run through the same streets and cut each others' fares, would inevitably result in the end of all competition within a very short time; whereas, if each company, whether operating street railway or omnibus, is given its own territory so that the field of competition is limited, the tendency will be to keep both in operation so that each will strive to outdo the other in quality of service.

From the above brief review it should be clear that the coming of the motor omnibus means large benefits to the public and to engineers interested in transportation development. It promises to have so important a bearing upon many engineering problems during the next dozen years that engineers should be well posted upon its possibilities.

LETTERS TO THE EDITOR

Suggestion for Improvement of Engineering English

Sir—Mr. O'Brien's article on Engineering English on p. 914 of ENGINEERING NEWS, of Nov. 6, calls to mind my experience in a Western polytechnic institute just before I entered college. The higher courses in this school were equivalent to the freshman and sophomore courses in college, but there were also lower courses clear down to a primary department for boys 10 to 14 years old.

In all the shop, laboratory and lecture courses, notebooks had to be kept. These were handed in at regular intervals for marking. That, however, was not all: when the instructor had marked the books for his subject they next went to the English Department. If that department did not not like the writing, spelling or grammar, the offender was notified to appear in the Primary Department an hour every day for two weeks. The injury to the dignity of an upper classman can be imagined. Many were the evenings spent in erasing hurried notes and rewriting them to avoid the consequences.

One or two of these sentences were sufficient to reform most of my classmates; but my case must have been hopeless, for I generally received a new sentence before the preceding one had been served. Fortunately, the sentences were not cumulative. No matter how many might have been superimposed upon each other, it was always possible to escape by serving faithfully an hour a day for two weeks and carefully revising all class notes taken during the same period.

If this suggestion should lead to the adoption of any such system by our present-day universities, I hope they'll not let the students know that I had anything to do with it!

G. S. W.

New York, Nov. 12, 1913.

Operation of the "Bull Dog" Gasoline Rock Drill

Sir—On the editorial page of your issue of Nov. 6, there appears an article entitled "Evolution of the Gasoline Rock Drill." In this article, you state that the "Bull Dog" Rock Drill, manufactured in Philadelphia, was operated by a separate engine through a flexible shaft, and that the drill, though satisfactory in its cutting, was short lived, through crystallization.

Your statement of the method of operation of the "Bull Dog" Drill is incorrect, as that drill was strictly a self-contained, piston-stroke drill, operated by explosion of hydro-carbon gas, mixed with air, compressed in the cylinder of the drill.

We are anxious that you should make a correction of your statement, inasmuch as our company is the only one now (or heretofore) manufacturing a portable power drill, operated in the manner you describe, namely, by a separate power of any kind (gasoline engine or electric motor), through a flexible shaft connection.

FOWDEN G. & E. ROCK DRILL CO.,
M. D. BALDY, Secretary Treasurer.
407 Land Title Bldg., Philadelphia, Penn.,
Nov. 10, 1913.

[We publish the correction with pleasure, as our statement was in error, as stated. The description of the "Bull Dog" gasoline rock drill, published in ENGINEERING NEWS, of Apr. 13, 1905, p. 385, shows that this drill was operated by a self-contained engine, as stated by Mr. Baldy. It was manufactured, in 1905, by the Gasoline Rock Drill Co., of 218 South 4th St., Philadelphia, Penn.—ED.]

Value of Engineering Society Membership

Sir—It would seem that a reply should be made to a letter printed in your issue of Sept. 11, with reference to the value of membership in the American Society of Civil Engineers. I regret that Mr. Kirkpatrick's experience has been so unfortunate, and feel sure that it is far from general. My own experience has been the direct reverse in practically every respect.

When in New York I nearly always call at the society rooms and rarely fail to meet congenial company in the shape of old friends or acquaintances. Curiously enough, it was during such a brief visit lately that I came across Mr. Kirkpatrick's letter.

If the value of membership is to be based on the sordid basis of the financial returns that a member may expect, I might suggest that the library alone is of sufficient value to pay every member splendid returns on his investment. This library is at the service of members in any locality, as searches will be made by the librarian at actual cost. The society papers alone are also easily worth the annual dues.

Mr. Kirkpatrick states that his membership never helped him land a job. I will again venture to state my

own experience. During the panic of 1907, or rather early in 1908, I arrived in New York, just before the annual meeting, on the lookout for a job. At this meeting I met an old acquaintance who offered me a position which I accepted. Without doubt, this was a direct result of membership in the society, and this during a time when jobs were mighty scarce.

Suppose we look at the social side. The semimonthly meetings are usually well attended by the resident members and are the occasion of considerable enjoyment. The Annual Meetings in January have always been a great interest and pleasure to me.

It seems Mr. Kirkpatrick does not see that wearing a pin does him any good; perhaps a recent instance from my own experience will show the potential value of a pin. While traveling a few weeks ago an elderly gentleman sat opposite me, who also wore the society pin. This led to a conversation, and an exchange of experiences, which to me at least was of great value.

It does not seem to me the function of a learned Society to act the part of a Boniface. There are numerous eating places within a short walk of the Society rooms.

In conclusion I wish to say that I feel proud to be a member of the Society and cannot see wherein it could be improved.

MEMBER AM. SOC. C. E.

Baltimore, Md., Nov. 7, 1913.

Deny Agreement of an "Economical" Concrete Design with the Joint Committee Report

Sir—Without criticism as to the economy of "Subscriber's" design of a reinforced-concrete girder and columns in the issue of Oct. 30, I would like to ask whether the Joint Committee's report would indicate that one stirrup of size shown (1¼-in. square bar) could take the place of a larger number of smaller diameter, which arrangement would allow the bond stress in each stirrup to be fully developed. It would seem that in the single stirrup of large diameter the bar would pull out of the concrete with loads shown, before developing one-half of the allowable tensile strength.

A. R. JAMES.

New York City, Nov. 8, 1913.

Sir—The "Economic" concrete design given in a letter in your issue of Oct. 30 assumes a load of 100,000 lb. on top of a 13-in. square column reinforced with four 1-in. bars with wire hoops apparently about 18 in. c. to c. According to the specifications of the Joint Committee, only the area within the hooping is to be considered effective, in this case about 10 in. square. Assuming the ratio of the modulus of elasticity of steel to that of concrete as 12, as did the author, this column will carry 50,000 lb. on the concrete and 24,000 lb. on the steel, or a total of only about 74,000 lb. or about 30,000 lb. short of the actual load. Furthermore, wire hoops 18 in. c. to c. are not usually considered sufficient for columns under any appreciable load.

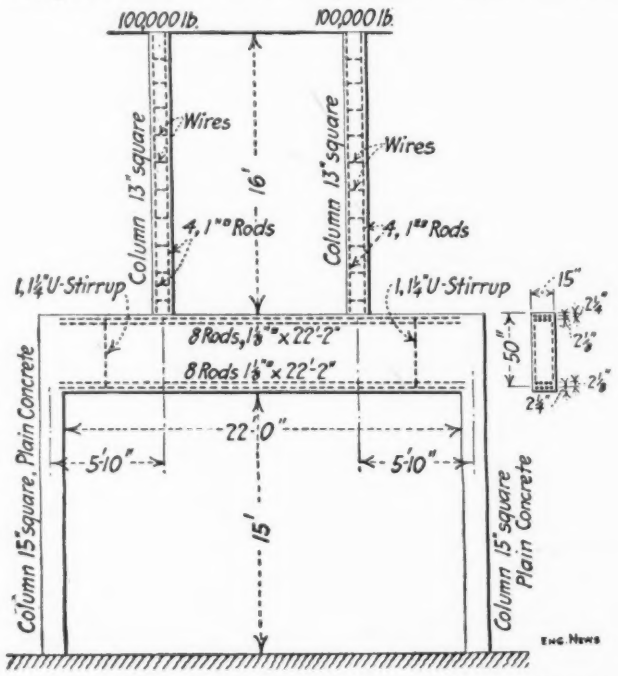
Next considering the beam as shown in the author's sketch with the load acting, including the weight of the column and beam itself, the author has a maximum shearing stress on the section at the edge of the column under the column of about 150 lb. per sq.in. According to the recommendations of the Joint Committee this should be limited to 6% of the compressive strength of the concrete, or 132 lb. with the class of concrete the author assumed. This is also on the assumption that the diagonal tension is thoroughly provided for with web reinforcement. The author showed one 1¼-in. U-shaped stirrup. This style of stirrup would be practically impossible as the material is so large that the main reinforcement would have to be crowded together, which should not be done. Furthermore, there would also have to be some hook provided at the top to develop the strength of the stirrup at the neutral axis, as the embedment above the neutral axis is not sufficient (about 36 in. is required).

The lower columns are perhaps the poorest features of the whole design, having no steel in them. The instant the beam deflects under load it will throw a bending stress into the columns, which they are very ill fitted to take. Even if a construction joint be placed just under the beam the center of pressure on the column will not be central on the column when the beam deflects. This will put a considerable eccentricity moment in the column which will perhaps produce a fiber stress on the outer face of the column sufficient to overcome the direct load unit compression.

DONALD N. BECKER.

Chicago, Ill., Nov. 5, 1913.

Sir—My attention has been called to a communication in your issue of Oct. 30, signed "Subscriber," giving what purports to be an Economical Concrete Design. The design is said to be strictly in accordance with the



ECONOMICAL CONCRETE COLUMNS AND GIRDER DESIGNED AFTER JOINT COMMITTEE'S PRESCRIPTIONS

[Reprinted from "Engineering News," Oct. 30, 1913, p. 886.]

rules of the report used by the Joint Committee, and it should not be allowed to stand as such on account of the fact that it includes a number of serious misinterpretations of that report.

In the first place, referring to the columns of the lowest story, the Joint Committee Report calls for reinforcement in one of the ways described for all columns of which the height exceeds six times their least dimension.

In the second place, the vertical shear in the end panel

of the design shown amounts to about 160 lb. per sq.in., while according to the Joint Committee Report not over 120 lb. per sq.in. should be used, when the reinforcement is distributed in accordance with the best possible design. Such a design should require, among other things, some of the horizontal reinforcing bent up and should require the vertical stirrups to be merely in section, and well distributed. The distance of three-quarters of the depth is given as a maximum, and not as a fixed spacing.

Besides these two features in which the design does not correspond with the recommendations of the Joint Committee, the author has himself called attention to the fact that the stress in the main reinforcing rods exceeds the limit allowed.

J. R. WORCESTER.

79 Milk St., Boston, Mass., Nov. 11, 1913.

Sir—I notice on p. 886 of the issue of Oct. 30 a letter from a subscriber entitled "An Economical Concrete Design."

Although purporting to be based on the Report of the Joint Committee on Concrete and Reinforced Concrete, the design agrees with this report in scarcely a single particular and is opposed to ordinary principles of mechanics. As it stands, the design is absolutely absurd and dangerous.

Special points to which I would call your attention are as follows:

Diagonal tension in the beam exceeds by a large percentage the requirements of the Joint Committee for ordinary concrete.

The stress in steel in tension, as stated by the writer himself, exceeds Joint Committee requirements.

Bond in stirrups is not provided for either by length or by anchorage as required by the Joint Committee, so that the stirrups shown are absolutely inadequate.

Bending stresses in lower columns, due to eccentric loadings, are not provided for as required by the Joint Committee.

Since the structure is not braced on a plane perpendicular to the plane of the drawing, the unsupported length of column is 33 times the least diameter instead of the 15 times required by the Joint Committee for columns effectively reinforced.

Joints between beam and lower columns evidently were not studied as required by the Joint Committee, since no reinforcement is provided to prevent failure by bending at connections.

SANFORD E. THOMPSON.

Newton Highlands, Mass., Nov. 14, 1913.

Excess Cement in Concrete

Sir—The writer has noted the editorial in your issue of Oct. 30, 1913, p. 879, advocating the use of a larger proportion of cement than is ordinarily called for in present-day concrete, with the object of increasing its durability, through decreasing its permeability and incidentally thereby increasing the compressive strength of the material.

Admitting the porosity of much present-day concrete to be a pronounced factor in its deterioration, and that reducing this characteristic would materially increase the material's life and allay many fears as to its ultimate durability, it is very questionable whether the mere addition of a larger percentage of cement to a fixed quantity of fine and coarse aggregate would result in a better, i.e., stronger, concrete eventually, even though this additional fine material, cement, might decrease the porosity of the material through void filling.

When decreased porosity can be satisfactorily obtained through the incorporation or admixture of inert non-cementitious material, there appears no good reason for using cement for this purpose except to incidentally give increased strength to the concrete. But the danger herein lies in the fact that a very large percentage of commercial cement is not mechanically fine enough to be promptly hydrated and so immediately effective, but in time when acted upon may cause expansion and deterioration of the concrete. Consequently when more cement is used than actually necessary to thoroughly coat the fine aggregate and fill its voids, the more are we introducing additional disruptive force. This is instanced by the greater tendency of the richer concrete to develop cracks due to expansion and contraction.

Of course the above statements in no way question the fact that laboratory tests all show that richer concretes develop greater strength under compression than leaner mixtures and this undoubtedly holds good until too much cement is used, when in time the disruptive action of an excess of this material overcomes its cementing characteristics.

The true explanation, in the writer's opinion, of the failure of much of the latter-day concrete construction to withstand weather and water attack through its oftentime obvious lack of impermeability, is not inherent in the material. It is often the result of the way concrete is mixed these days, very wet, in order that it may be spouted over comparatively long distances, when separation of the several entities of the concrete naturally results with consequent development of pockets and general increased porosity.

W. A. AIKEN,

Vice-President, Henry S. Spackman Engineering Co.

Philadelphia, Penn., Nov. 4, 1913.

Sir—I will not attempt to answer the editorial query "Why not use more cement in concrete"? but I feel that it suggests the wrong answer to the increasingly pressing question: "How are we to lengthen the life of concrete structures"? We all admit that a 1 : 1½ : 3 is a splendid material; in fact, it probably is as dense a concrete as can be made; but it is also about as expensive as one wishes to specify, except for very special work.

It is my belief, however, that the answer to the problem is not more cement, but *better* cement, or better methods of mixing ingredients. To use more cement is a good argument from the standpoint of the cement manufacturers and an encouragement for them to turn out an even more inferior product so that eventually sand will have to be eliminated from concrete.

I believe that more attention is given to the design of concrete structures than to the improvement of the material itself. Some time ago you published some matter on the effect of an excess of water in concrete. That is the kind of research needed; just what percentage of water should be used, just what degree of fineness or coarseness should the sand possess, and the same data as to the stone. The qualities of different combinations, and experiments toward improving the cement itself, should be diligently and continuously studied—not by

college professors and students—by a commission of *engineers* who possess in about equal proportions theory and practice—imagination and accomplishment.

Suppose 10 of the principal cities of the country should appropriate $50,000 each for the maintenance of such a commission; it surely would be a trifling expenditure toward a great ultimate saving. Perhaps the States should appropriate the money, perhaps the federal government—although I favor the cities plan as promising the greater returns—anyhow, let some continuous, expert study take the place of, or perhaps better, be in addition to, the present intermittent and isolated, collegiate experimentation in this most important field of construction.

WALTER R. MASON.

40 Argyle Pl., Arlington, N. J., Nov. 6, 1913.

Present Status of the Subway Situation in Chicago*

BY WILLIAM J. SHANKS†

The City Council of the City of Chicago has authorized an advertisement for proposals to construct a comprehensive system of passenger subways, within the city limits, that will be operated independently of existing surface and elevated transportation lines, and that will be ultimately municipally-owned, through the amortization of the construction debt out of earnings.

The ordinance authorizing these invitations to private capital, to enter into a subway construction partnership with the City of Chicago, specifies certain subway routes that approximate fifty-seven miles in extent, or approximately 135 miles of single track, for which the construction estimates approximate $96,000,000 for subway construction, and $34,000,000 for equipment, or an estimated total of $130,000,00.

The ordinance further specifies the form in which proposals for construction and equipment are to be made, the object being to secure competitive bids on the proportion of estimated gross receipts, from the operation of subways, that contracting parties may consider a necessary return for their investment.

The bids are also to specify: (1) What proportion of gross receipts shall be applied to a sinking fund to amortize the construction debt. (2) Rate of division between Company and City of the remaining gross receipts, after providing for operating expenses, interest on investment, and sinking fund.

As the City's grant of operating privileges is limited, by statute, to 20 years, it follows that a liquidation of the construction debt will be based on the prospective subway earnings during the 20-year operating period.

It is further implied, in the preliminary subway ordinance, above mentioned, that prospective bidders shall have free access to the general plans and specifications, for the proposed comprehensive system of passenger subways, now on file in the offices of the Chicago Harbor and Subway Commission, and it is taken for granted that the tables of prospective traffic on given subway routes, and other working data, as prepared by the Harbor and Subway Commission, will be analyzed and verified by prospective bidders.

It is provided that any proposal for the construction and equipment of a comprehensive system of passenger subways, in the City of Chicago, must be accompanied by a deposit with the City Treasurer of $1,000,000, in cash or securities. Such deposit will be returned to any unsuccessful bidder, and will be retained by the City as liquidated damages if, after the awarding of a contract to a successful bidder, the latter fails to comply with the terms of the contract.

The City Council has further directed, in the ordinance above mentioned, that on the receipt of proposals for the construction of a comprehensive system of subways, the same shall be canvassed, and if any proposal is deemed acceptable by the City Council, it shall be incorporated in a second ordinance, containing, in substantial form, the detailed requirements of the first or preliminary ordinance; and that the said second ordinance, containing the name of the person, firm or corporation whose proposal has been accepted, shall be submitted to a referendum vote of the citizens of Chicago, at the municipal election on the first Tuesday in April, 1914.

*From a statement issued to the press and public.

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At the latter election, it is proposed to give the citizens of Chicago an opportunity to express their preference for one of three alternative plans, for beginning the construction of passenger subways in Chicago, as follows:

1. For a comprehensive system of thorough-route, high-speed passenger subways, extending approximately to the city limits on three sides, to be built by private capitalists, named in the ordinance, on such terms of partnership with the City as will secure the gradual liquidation of the construction debt out of earnings, leaving the actual subways municipally-owned, and providing for the future transfer of operating equipment to the City, or a new lessee, at the end of a 20-year operating period.

2. For a limited system of passenger subways, in the downtown district, to be built by the municipality itself, out of present and future accumulations in the "traction fund"; such city-owned subways to be leased to the present owners of Chicago's elevated railroads, for the latter's exclusive use, as a downtown clearing house for the elevated railroad system.

3. For a limited system of passenger subways, in the downtown district, to be built by the municipality, out of the "traction fund," possibly supplemented by direct financial aid from the surface car companies, as suggested in the 1907 traction ordinances; the said downtown subways to be used exclusively for the routing of a proportion of surface car traffic.

It is expressly provided, in the first "comprehensive subway" ordinance, that the second "comprehensive subway" ordinance, when submitted to the voters at the April election, shall become a law only, (1) if it secures a majority of the votes cast thereon, (2) if it secures a greater number of votes than the votes cast in favor of the elevated road subway ordinance, and (3) if it secures a greater number of votes than the votes cast in favor of the surface car subway ordinance.

It will be noted that, in the last two mentioned plans for beginning subway construction in Chicago, there is no necessity for competitive proposals, and that the operating terms to be arranged, if either plan is chosen by the voters, are confined to the elevated railways in one case, and to the surface railways in the other case.

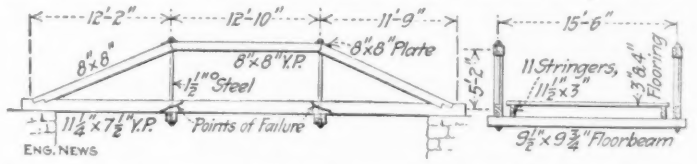
This leaves the first-mentioned alternative plan—that of a comprehensive, city-wide system of subways, as the only plan in which competitive proposals are invited; the said competitive proposals being essential before a definite ordinance can be submitted to the voters.

Further, it becomes necessary to emphasize the fact that such competitive proposals, for a comprehensive system of passenger subways, must be received by the Chicago City Council in ample time to permit the canvassing of the same, and the drafting of a second ordinance for submission to the voters on the first Tuesday in April, 1914.

This leaves the margin of time very limited, and the City's formal advertisement for proposals will be prepared and published within the shortest time possible.

Failure of a Small Highway Bridge by Breaking of a Timber Tension Chord

A small wooden queen-truss highway bridge which spans the abandoned Pennsylvania Canal at Harrisburg, Penn., collapsed under the weight of a motor truck, on Oct. 27, 1913. The bridge was on a spur road



SKETCH OF SMALL QUEEN-TRUSS BRIDGE WHICH FAILED

to the plant of the Pennsylvania Reduction Co., where the city garbage is disposed of. The general details of the bridge design are shown in the accompanying sketch, sent us by J. R. Hoffert of Harrisburg.

The collapse occurred when a motor garbage truck, weighing with load about 8600 lb., reached the middle of the bridge. The lower chord of the north truss failed and the resulting collapse carried the floor system and

the truck to the canal bed below, where the truck rested upon the wreckage. The south truss probably remained intact.

The lower chord of the north truss was found broken in *two places*. Both breaks were at the holes through which passed the 1½-in. hanger rods. This chord was in direct tension, with secondary bending due to distortion of the truss; both of these actions would produce maximum stresses at the panel-points. Probably the bending continued after the primary breaks and broke the chord at the other hanger.

The floor planking, originally 3 in. thick, had been partially repaired with 4-in. plank a short time before the accident. The resulting roughness of the floor may have increased the stresses in the structure considerably by impact.

Engineers for the New York Public Service Commissions and as Heads of New York City Departments

The Public Service Commissions of New York, established during Gov. Hughes' administration, have a larger responsibility and greater powers of control over the operations of railway and municipal utilities than any other body of men in the United States, save possibly the Interstate Commerce Commission.

In the original appointment of these commissions, Gov. Hughes selected one engineer, Mr. Jas. E. Sague, late Vice-President of the American Locomotive Co., as one of the members of the Second District Commission. Since then, however, in filling vacancies upon the Commissions, no engineers have been selected; and this is nothing strange since in the appointments made by Gov. Dix and Gov. Sulzer, political motives appear to have been the chief consideration.

Recently a Committee of the American Institute of Consulting Engineers appeared before the new Governor of New York, Hon. M. H. Glynn, and urged that in filling future vacancies on the Commission engineers should be selected. The argument made by the Committee is so strong and applies so well to the selection of engineers for other important administrative positions in connection with public works that we print the substance of it as follows:

We appear before you as altruists, animated by a sincere desire to perform a public duty, to explain to you why the public interest will be well served by the appointment by you of engineers of broad training to the Public Service Commissions of this State.

Both of these Comissions have duties of a highly technical character, calling for a combination of administrative skill and engineering knowledge that can only come through years of experience with the supervision and initiation of great public utilities.

The Commission of the Second District has first to do with the safety of travel on the railroads that ramify the state. The strength of bridges, the quality of rail, the use of uptodate signals and the general condition of tracks and roadbed for meeting the exacting needs of fast and heavy trains are matters that call for technical foresight and experience. The consideration of plans for the costly enlargement of terminals and for the elimination of grade crossings, is the next duty of the Commission that requires technical skill of a high order to see that corporate and public interests are alike well served. The passing of judgment by the Commission on applications for authority to create rival lines and other utilities, certainly demands an intimate knowledge of the engineering matters at issue, coupled with administrative and judicial qualifications.

Finally, the investigation of the cost of service in the regulation of rates can only be intelligently done when illuminated by the mind of the experienced engineer.

All of these features are embraced in the daily duties of the up-state Commission, and also of the Commission for the First District, which latter in addition has an added duty in the initiation and construction of a work that rivals in importance the Panama Canal.

The building of new subways in New York City primarily calls for the talents and experience of the engineer, the lack of which was strongly shown in the plan of the original triborough system, that was abandoned, to the great saving of the City of New York, after a public mass meeting of engineers had exposed the inherent faults of its general layout and detail design. It is not necessary, however, to point to the past need of engineering experience in the broader aspects of the subway problem. At the present time, after several years of work, we see many miles of new subways approaching completion, while a vital connecting link at 42d St. and Lexington Ave., in many respects the most difficult of all, has not yet been even definitely located, let alone placed under active construction. The trained administrative engineer surely would plan the building of this great work so that the construction of the various parts would be commenced at varying intervals, so that all would be completed at the same time. The failure to do this in New York will result later in cries of scandal over a delay of years in opening the new system; and the loss to the taxpayers of millions of dollars in wasted interest charges on idle capital, a loss just as real as if the money were burned in a public place.

In reply to the argument that the engineer should be represented on these technical Commissions, the answer often has been made that he can be hired as a subordinate. The highest type of engineer cannot always be secured in this way, any more than would be the case with other professions. The honor of serving as a commissioner would prove attractive to the engineer of standing when the question of remuneration would offer no appeal to him whatever. Then, too, the engineer of broad training on the Commission would command the respectful attention of his colleagues, an attention which too often is lacking when equally sound advice may be given by a subordinate official.

Certainly the leading private corporations of the country show their realization of the wisdom of having engineers in their councils, as instanced in enterprises like the change of motive power on the New York Central and the new tunnels and station of the Pennsylvania R.R. at New York, and other great works throughout the country, as well as in the general management of public utilities, as on the Pennsylvania R.R., Southern Pacific R.R., and more recently on the New York, New Haven & Hartford R.R. In our National Government we have the creation of the Panama Canal under Col. Goethals as a shining example of the administrative work of the engineer; and in civic affairs, the creditable building of the great aqueduct at Los Angeles.

Abroad we may take inspiration from the example of the cities of Germany, which owe their marked industrial, social and æsthetic advance to the engineering talent to which they have entrusted the direction of their affairs.

If further illustration is necessary, attention may be directed to the many legal, medical and theological commissions from which the omission of representatives of their respective professions would not be considered, let alone permitted.

In thus urging the appointment of engineers on the Public Service Commissions, we recognize that their selection should not be based on their technical attainments alone, but also on the same degree of business and administrative acumen that should be possessed by appointees from other walks of life.

Should you conclude to act on our suggestions, we believe that a list of suitable names would be presented for your consideration through a request to the presidents of the five national engineering societies of the country, acting possibly in conjunction with the president of a leading commercial body like the Chamber of Commerce of the state of New York.

The Institute has further addressed a memorial to the Mayor-Elect of New York City, John Purroy Mitchel, urging the selection of engineers as the heads of important city departments. We quote from the letter as follows:

The American Institute of Consulting Engineers is a National body of restricted membership both as to numbers and qualifications. Membership therein is confined to professional engineers in independent private practice, and of such prior experience and professional standing as enables them to serve their clients in an advisory, consulting or executive capacity, and the Institute's membership consists, therefore, of only the older and more experienced of the engineering profession in its various branches.

The Institute has no candidates to present for office, and is, therefore, enabled to address you from an impartial standpoint in behalf of the best interests of this city and of good government.

We recommend that the following offices should be filled by engineers:

Commissioner of Bridges; Commissioner of Docks and Ferries; Commissioner of Water Supply, Gas and Electricity; Change of Grade Damage Commission (at least one member); Board of Catskill Water Supply (at least one member, together with perhaps some others.

In thus urging the appointment of engineers to the heads of these departments, we emphasize the fact that a selection should not be based upon technical attainments alone, and that high character, tact and business and administrative ability are absolutely necessary qualifications besides for anyone competent to fill these positions, and we believe that these departments cannot be administered with the efficiency and economy that you desire unless they are under the leadership of such types of engineers.

That such men are obtainable from our profession is proven by the fact that many private and Public Service Corporations of this country have recognized this in selecting engineers for the highest executive offices.

The presidents of the Pennsylvania, Delaware & Hudson, and many other railroads which are standards of excellence in their service to the public and are showing economical and financial results for their stockholders, are engineers.

Abroad we may take example from the cities of Germany, which largely owe their marked industrial, social and æsthetic advance to the engineering talent to which they intrust the direction of their affairs.

An argument is often advanced by politicians and others that it is not necessary to have engineers as heads of departments, because competent engineers can be hired as subordinates. To this we answer that there are degrees of competency in the engineering profession as there are in the legal and other professions, and that the higher type of engineer will rarely serve in a subordinate position in departments under laymen.

The same argument should be advanced as to the position of Corporation Counsel, or as to the head of the Board of Health. Why not place practical (so called) business men at the heads of these bureaus and let these employ legal talent or medical and sanitary experts? The answer is obvious. Experience has shown the necessity of putting at the head of these departments men who know their business.

It is noticeable that when members of the legal profession are appointed to office, they are usually chosen from among the higher ranks; so in the selection of an engineer, we ask that you consider only the engineer of experience and standing, and with past performances to his credit.

The Commissioner of Bridges of this city is charged with the direction of the design, construction and maintenance of the bridges of the city as well as the administration and operation of the Brooklyn Bridge and its transportation facilities, and under his jurisdiction there are about 4000 employees. We cannot conceive of a private enterprise employing anyone but an engineer, to direct an organization of this character.

The Dock Department has functions largely of a highly technical character, and a Commissioner without practical engineering training and experience in the details of construction cannot but make mistakes, costly to your administration and the public; but on the other hand to the competent engineer, the excution of such details is the mere routine work of one familiar with the problems involved.

The Department of Water Supply, Gas and Electricity is in the business of furnishing water, fuel and light to the city and the public, all matters of a highly technical nature, which in private corporations, dealing with these same public utilities, are in charge of engineers.

The Board of Water Supply being the administrative head and executive authority for the construction of this city's new water supply, has under its control the expenditure of more millions of money than the cost of the terminals of the Pennsylvania R.R. in this city. This latter corporation placed the sole responsibility of this great work in the hands of a Commission composed only of engineers, while in the former there is not a single engineer on the Commission.

The Panama Canal with which the city's new water-supply may be justly compared in point of cost and engineering importance, is approaching successful completion under the sole executive control of one enginer, thus justifying the policy of the Federal Government in this respect.

While the important details of construction of the new water-supply are in the hands of a capable and experienced engineer, we submit that the interests of the city would best be served by the appointment of at least one engineer member to the Board of Water Supply.

The Change of Grade Commission we believe should also contain at least one engineer representative because of the technical and constructive matters with which it frequently deals.

Hence there are three Departments and two Commissions dealing wholly with the construction and maintenance of engineering works, and the administration of municipally operated plants of a highly technical nature. These under any efficient business organization would be in charge of engineers, trained by long experience in the respective branches of engineering to which their departments pertain, men who have given a lifetime of study to the problems involved and who have worked up from their apprenticeship through various positions to executive office. Unfortunately, the past custom in this city has been to appoint to these offices men with no previous training or experience in the technique or affairs of the office they are called upon to direct. This results in errors very costly to the public, and a loss of that efficiency and economy that you so justly seek.

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Unusual Features of a 48-In. Cast-Iron Water Main across a Salt Marsh to Atlantic City, N. J.

By T. Chalkley Hatton*

A contract has just been executed between the City of Atlantic City, N. J., and the Atlantic Construction Co., of the same city, for constructing a 48-in. cast-iron force main under physical conditions which require unusual construction methods. To understand the necessity for these unusual methods a brief history of the present force mains over the salt marshes must be given.

Topography between the City and the Source of Water Supply—Atlantic City occupies the greater part of the island of Absecon, which is surrounded by the Atlantic Ocean on the south and the Great Thoroughfare on the north. This thoroughfare is navigable, connecting with the ocean at both ends, and is about 500 ft. wide at a point about midway of the city, and at the point where the forcing mains reach the city.

Between the Great Thoroughfare and fast land to the north there is a level salt marsh about 16,000 ft. wide. The surface of this marsh is about 6 in. above mean high tide; the average rise and fall of the tide is 4 ft. Very frequently during the year the entire surface of the marsh is covered with salt water due to high northerly or easterly winds. The surface is exposed, however, at each low tide for the water rapidly passes off through the numerous natural and artificial water courses existing throughout the area.

The public water-supply of the city is obtained partly from several deep wells driven to fresh water in sand strata on the fast land about five miles north of the Great Thoroughfare, and partly from a surface supply, the entire watershed of which is owned by Atlantic City and amply protected against possible pollution.

Present Water-Works—The pumping station is located near the driven wells. The two classes of waters are mixed in two small receiving basins and pumped direct through several forcing mains to the city, a distance of about five miles. Each of these forcing mains must necessarily cross the three miles of salt marsh above described. Cast-iron, steel and wood mains have each been used, and the effect of the salt marsh upon these mains has resulted in building the new main by an entirely new method.

The first main was a 12-in. cast-iron, class B, hub and

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spigot pipe, laid in 1882, about 2 ft. under the surface of the marsh. The second main was a 20-in. cast-iron, Class B, hub and spigot pipe, laid in 1888 about 2½ ft. under the surface of the marsh. The third main was a 30-in. riveted-steel pipe, ¼-in. thick, laid in 1901, the top surface being about 6 in. above the surface of the marsh. The fourth main was a 48-in. continuous wood-stave pipe, 2 in. thick, banded with ⅝-in. wrought-iron

FIG. 1. DISINTEGRATION OF A 20-IN. CAST-IRON WATER MAIN LAID THROUGH A SALT MARSH, ATLANTIC CITY, N. J.

bands, which were spaced for a 100-lb. pressure. It was laid in 1910 and 1911. The axis of the pipe is level with the surface of the marsh, and the top half of the pipe is covered with the marsh turf from 6 to 10 in. thick.

EXPERIENCE WITH CAST-IRON PIPE—During the past ten to twelve years the two cast-iron pipes have caused frequent trouble by actual disintegration, resulting in large pieces of the pipe being blown out. Fig. 1 shows

FIG. 2. LEAK IN A 30-IN. RIVETED-STEEL WATER MAIN LAID THROUGH A SALT MARSH, ATLANTIC CITY, N. J.

a photograph of a section of the 20-in. pipe as it was removed from the main after a blow-out, and it is fairly representative of the usual blowout in both the 20-in. and 12-in. pipes.

The disintegration does not occur in holes like the pitting in steel pipe, but appears to be a softening and wearing away of the metal leaving crystalized globes of metal connected together by thin veins of good metal. With a sharp cold-chisel the outside surface of the pipe can be easily scraped off, the scrapings having more the appearance of carbon than of oxide of iron. The condition of the pipe is worse near the top than on the outside bottom, and clearly indicates that the deterioration is caused by some combination of vegetable matter, salt water and air. Much of the 12-in. cast-iron main has been out of service for some time owing to the frequent breaks in it through the marsh.

FIG. 3. REPAIRING LEAKS IN RIVETED-STEEL WATER MAIN WITH WOOD PLUGS, ATLANTIC CITY, N. J.

EXPERIENCE WITH STEEL PIPE—The 30-in. steel pipe requires constant attention to keep it in service. It is badly pitted throughout its length in the marsh. Two years after it was put in service the pitting, in many places, penetrated through the metal and caused leaks; and from that time up to the present the condition has grown rapidly worse. This riveted-steel main where it crosses through the marsh is to be entirely abandoned as soon as the new 48-in. cast-iron main is completed.

Fig. 2 is from a photograph of a pit in the steel main and illustrates the general shape and character of the pitting which usually results from electrolitic action in steel and cast iron. Fig. 3 shows a common method of repairing such leaks. The first pit is filled with a wooden plug, and as this pit increases in size other wooden plugs are added until a great many plugs are used, as the photograph shows. When the hole becomes so large that plugs can no longer be used, a concrete block is placed over the hole and attached to the pipe with wrought-iron bands. This condition exists throughout the length of the pipe. The disintegration in this steel main is in the form of pitting only.

There is very little pitting to be observed on the top of the steel main, which is about 6 in. above the surface of the marsh. The greater portion of the pitted area is at points in contact with the vegetable roots of the marsh turf, and the pitting seems to be due to chemical combinations between the retained salt water and vegetation. The bottom of the pipe which is constantly in contact with the salt water, but not in contact with the turf or other vegetable matter, is not much affected, and in many places examined by the writer, the original coating is still intact.

The specifications under which this steel pipe was laid provided for a coating of Assyrian Asphalt Co.'s

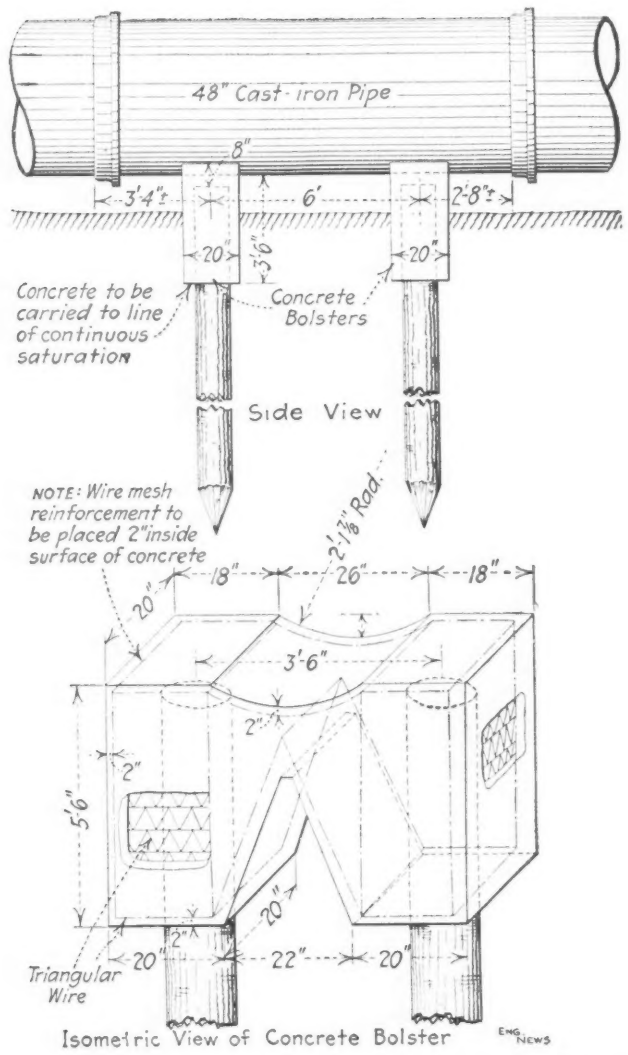


FIG. 4. DETAILS OF PILE BENTS AND CONCRETE BOLSTERS FOR CARRYING A 48-IN. CAST-IRON WATER MAIN THROUGH A SALT MARSH, ATLANTIC CITY, N. J.

"Mineral Rubber Coating" and a wrapping of one thickness of burlap. The coating was applied at a temperature of 400° F., to insure its adhering firmly to the coating. Above the outside bottom of the pipe there is very little evidence of either the coating or the burlap, the latter having long since rotted.

The chemical composition of the steel, as specified, was 0.05% sulphur, 0.05% phosphorous, 0.05% silica and 0.5% manganese. It was to be made by the open-hearth process and of the grade known as "soft" steel.

FIG. 5. BOLSTERS IN PLACE READY TO RECEIVE 48-IN. CAST-IRON MAIN

It is only fair to state that where the steel and cast-iron pipes are laid in the fast land from the marsh to the pumping station, a distance of over a mile, their condition appears to be very satisfactory, and no indication of serious disintegration is apparent. This section is built entirely through dry sandy soil.

EXPERIENCE WITH WOOD-STAVE PIPE—The wood pipe has only been in service two years and is in first-class condition, so far as observed, although the wrought-iron bands show some corrosion. A complete description of this wood pipe line was given by L. Van Gilder, Chief Engineer of the Water Department of Atlantic City, at the annual convention of the American Water Works Association in June, 1913.

NEW CAST-IRON MAIN—The two cast-iron and the steel forcing mains having practically reached their period of usefulness, and the fire hazard of Atlantic City being too great to place entire dependence upon the one 48-in. wood forcing main five miles long, between the source of supply and the city, the City Commissioners decided to provide a second main, 48-in. in diameter, as soon as possible. Their choice was cast-iron because they felt that greater safety lay in having mains of both cast-iron and wood than in two wood mains, and their instructions to the engineers were to build the pipe line as permanently as possible having in view the past experience with the present cast-iron and steel lines.

CONSTRUCTIONAL FEATURES—Fig. 4 shows the method of supporting the new cast-iron pipe through the marsh. Two piles are driven spaced 3 ft. 6 in. c. to c. forming bents spaced 6 ft. c. to c. The upper ends of the piles project a few inches above the surface of the marsh and are capped by a concrete bolster reinforced with woven-wire metal. The bolster is 5 ft. 2 in. long, 20 in. thick, and deep enough to envelope the pile below the point of constant saturation, which is approximately 2 ft. below the level of the marsh. This bolster was curved upon its upper surface to a radius corresponding to the outside radius of the pipe. The reinforcing metal was added to overcome the tendency of the concrete to disintegrate through the action of expansion and contraction in its exposed position.

Between the pipe and the surface of the concrete bolster a sheet of hard vulcanized fiber 3/8-in. thick is placed. This is to prevent the cast iron from coming in contact with corroding substances in the concrete, which may be expected to be particularly active in the exposed position, especially as close contact could not be secured at all places between the perimeter of the pipe and surface of the bolster, unless the pipe was first laid and concrete

FIG. 6. COMPLETED SECTION OF NEW 48-IN. CAST-IRON WATER MAIN, ATLANTIC CITY, N. J.

afterwards run. This method of construction was not practicable.

The average length of the piles driven was 37 ft., the first 22 ft. of penetration being secured by the weight of a 2000-lb. hammer resting on the pile. The final penetration required was not over 1 in. under five strokes of the hammer falling 14 ft.

The bottom of the cast-iron pipe is laid about 1 ft. above the surface of the marsh and the grade is practically level for four miles.

The 6000 ft. just completed were laid during summer weather, and expansion was provided for by allowing a minimum space of ¼ in. between the shoulder and spigot end of each pipe. In the section still to be laid expansion will be provided both by this method and by inserting a solid sleeve every 2000 ft. in the pipe.

The new 48-in. cast-iron main is to be carried under the Great Thoroughfare in the form of an inverted siphon. The bottom of the thoroughfare is to be dredged to such depth as will allow a clearance of 13.7 ft. below mean low water. Hub and spigot pipe is to be used, except where vertical changes in direction occur, of which there are five. These changes are to be made with knuckle joints having a range of 10°. The pipe is to be laid upon pile foundations consisting of two bents to each section of pipe and two piles to each bent. These piles will be capped with an 8x8-in. yellow-pine timber.

Experimental Section—Inasmuch as the local contractors and the engineers had no previous experience enabling them to judge the cost of building such a pipe line across this marsh, and as the question of transporting materials over the marsh appeared to be a very difficult one, the City Commissioners decided to let a contract first for 6000 ft. of the pipe, which would enable all parties interested to determine the proper cost for the remaining 17,000 ft. and to judge whether changes for more economical construction might be desirable.

Cost Data—The first contract was let to W. G. Fritz, of Newark, N. J., at a total price per ft. of pipe laid of $18.80; of this amount the pipe cost $8.14 per ft., or $22.25 per net ton delivered f.o.b. car Atlantic City. The cost of the piles was 40c. per ft.; concrete bolsters $14 each; unloading, delivering and laying pipe, including hemp and lead for joints, $2.08 per ft. This contract was very successfully and satisfactorily completed by Mr. Fritz about Oct. 1, which was within his contract time.

The second contract for 17,100 ft., which has just been awarded to the Atlantic Construction Co., of Atlantic City, is at a total price of $14.34 per ft., of which the pipe cost f.o.b. cars Atlantic City, $7.50 per ft., or $20.49 per net ton. The piles cost 21c. per ft., the concrete bolsters $11.75 each, and the unloading, delivery and laying of pipe, including hemp and lead for joints, $1.71 per ft. In both cases the city buys the pipe direct from the manufacturer.

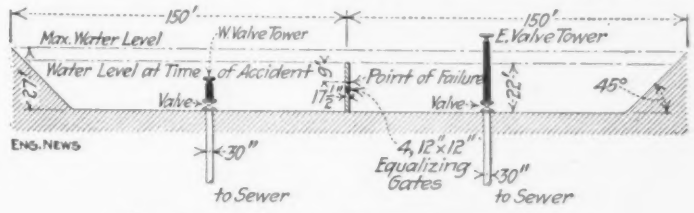
The method of letting out the short section first has been the means of saving to the City about $78,000 on the entire work, for there have been no changes of any consequence between the plans and specifications governing the constructing of the first section, and that of the last section. The 48-in. wood main already in service cost $10 per ft. complete. The 30-in. steel main cost $4.76 per ft.

Personnel—The general designs for the work were made by L. Van Gilder, Chief Engineer of the Atlantic City Water Department, who also supervised construction, the writer merely acting as Consulting Engineer. The 6000 ft. of cast-iron pipe already laid was furnished by the United States Cast Iron Pipe Co., and was as near perfect as cast-iron pipe of such a size can be made. The contract for the balance of the cast-iron pipe has been awarded to R. D. Wood & Co., of Philadelphia, Penn.

Collapse of a Thin Partition Wall in a Water-Works Settling Basin

A 17½-in. brick partition wall in the settling basin of the municipal water-works plant at Fort Smith, Ark., was pushed over by water pressure, on Oct. 26, causing the death of an assistant engineer. The Fort Smith "American," of Oct. 28, gives an account of the accident, and from this description we have gleaned the following information and constructed the accompanying approximate cross-section of the settling basin.

The basin is about 300x100 ft., and contained about 5,000,000 gal. of water at the time of the accident. A brick partition wall, 22 ft. high and 100 ft. long, crosses



Settling Basin, Fort Smith, Ark.

the center of the basin. The sides of the basin are 27 ft. in height, and have a 1 on 1 slope, while the bottoms of the two basins have a 5° inclination to the respective centers. In the center of each basin a 30-in. valve opens into the sewer.

In filling the basins, the water flows into the east half and through four 12x12-in. equalizing gates in the dividing wall, and over the wall, into the west basin. These gates open automatically into the east basin when the water pressure therein drops below that in the west basin, but they have no reverse action.

In the east half of the basin the vertical shaft which operates the sewer valve is carried up in a tower above the maximum water level; but in the other half of the basin the shaft and tower rise only about 16 ft. above the bottom of the basin.

In emptying the basins, the procedure was to open the east valve; the safety gates were depended upon to lower the west basin equally with the east until the west valve could be operated. Since the accident, it has been found that the area of the connection between the basins, provided by the safety gates, was but 452 sq.in., while the area of the 30-in. sewer outlet was, of course, 707 sq.in. In lowering, however, the maximum variation in head between the water in the two basins was only 8 in.

It is said that in the construction of the settling basin the central wall was laid up to a height of about 13 ft., and left thus for a considerable time before its completion. The failure appears to have occurred where the newer portion was joined to the lower section. The upper section of the wall, about 9x100 ft., broke into four pieces. The damage is estimated at about $1500.

Motor-Omnibus Operation

SYNOPSIS—The motor omnibus as a competitor of the electric street railway is one of the chief matters now prominent before European engineers, and is receiving extensive study in this country. The Board of Estimate of New York City has pending before it numerous applications for franchises to operate lines of motor busses. A report on these pending franchises was made on Nov. 5, by Harry P. Nichols, Chief of the Bureau of Franchises, and with this was presented the report of Mr. Nichols' principal assistant, John A. McCollum, who was sent abroad in August to study motor-bus operation in London and Paris. These two reports are the most authoritative statement that has appeared anywhere as to the cost and conditions of motor-omnibus operation. The following abstract contains the parts of the report of principal engineering interest.

Hon. Ardolph L. Kline, Mayor, Chairman of Board of Estimate and Apportionment:

Sir—Motor-bus transportation was brought to the attention of the authorities last year by an application made to the Public Service Commission by the Fifth Avenue Coach Co. now operating about 80 busses on Fifth Avenue, Riverside Drive and other streets, to extend its lines, particularly on Park Avenue.

The application was denied on the ground that public convenience and necessity had not been shown for the routes applied for. This led to an examination of the laws relating to stage coaches, and it was found that the Fifth Avenue Coach Co., in which the New York Railways Co. had a large interest, had a practical monopoly of the stage-coach business and any further extensions granted to it would be in the nature of unlimited franchises, which was repugnant to the Charter. The Board therefore was instrumental in securing an amendment prohibiting so called perpetual grants and terminating the legalized monopoly of the existing operating company. (See Chapter 769 of the Laws of 1913.) The result is that the Board has before it applications from four companies for rights to operate motor busses in the Borough of Manhattan.

Before committing the City it seemed desirable that the members of the Board should be made acquainted with results of motor-bus operations in London and Paris. I sent John A. McCollum, my principal assistant, to these cities in July to obtain such information as was possible in the three weeks' time available. Mr. McCollum has now made his report, which is appended hereto. The conclusions reached by Mr. McCollum plainly show that this City should proceed carefully in adopting a policy so that the benefits derived from such increase of transportation facilities will not be more than offset by its disadvantages, which would apparently accrue largely in four ways, as follows:

Firs—Increased congestion of street traffic.

There is no congestion at present in any part of New York comparable to that in many parts of London.

Second—Increase in street accidents.

The London table of fatalities and injuries shows a constantly increasing percentage as the number of busses has increased.

Third—Injurious competition with street surface railways.

From the time of the elimination of the horse busses in Manhattan, street railways have largely taken their place, except on Fifth Avenue. This has been done with the maximum outlay of capital on account of the underground system employed and also with a maximum long-haul fare of five cents. Competition of the motor busses has had a more unfavorable effect on the earnings of the tramways in London than the introduction of elevated or subway transit railways had on the earnings of the surface railways in New York.

Fourth—The additional wear and tear on pavements of a large number of heavy vehicles from six to eight tons loaded driven at fast speed.

Other vehicles than busses of greater weight are now employed in our streets and our pavements, particularly the foundations, will have to be made increasingly strong to withstand the same.

Considering these objections there yet seems to be a field where motor-bus transportation can be conducted with advantage to the public because of the congestion at certain hours of the day on the existing transportation lines and also because of the lack of facilities in certain local areas and directly between points where traffic might easily be induced.

The questions before the Board seem to be as follows:

First—Shall motor busses be permitted on the streets generally in competition with street railways?

Second—If general competition is not permitted, shall the Board grant additional franchises upon sufficient routes to test the feasibility of motor-bus operation without directly competing with existing transportation facilities?

Third—If limited routes are to be granted, shall more than one company be permitted in any street, and shall it be the policy to grant franchises to a limited degree to all companies whose applications are now before the Board or to one company only?

If the Board should adopt a policy of granting motor-bus franchises to a limited degree for the purpose of testing the feasibility of operation to one or more companies, then a study may be made of the routes which have been applied for by the various applicants with a view to deciding which should be permitted and a report shall be presented thereon by this Bureau. Until some such policy has been adopted it is almost impossible to proceed further with the drafting of franchises.

There are, however, certain conditions which might be pointed out as being necessary for any bus franchise to insure the safety and comfort of passengers and inhabitants and to prevent destruction of street pavement; that is, those conditions having to do with the size, weight, type, construction and operation of the vehicle, the government of which features, apparently, judging from the experience gained by London and Paris, it is important should be retained by the City. They should be governed by the franchises, either by specifying therein such details or retaining to the Board power to impose or change such conditions as may from time to time be deemed necessary. The need for this control is sufficiently shown by the report herewith submitted upon conditions in London and Paris.

In view of the foregoing it is suggested that the matter of bus operation be referred to the Franchise Committee in order that it may recommend to the Board a policy to be pursued with respect to the applications now before the Board affecting the Borough of Manhattan. Respectfully,

HARRY P. NICHOLS,
Engineer, Chief of Bureau of Franchises.

277 Broadway, N. Y., Nov. 5, 1913.

REPORT OF JOHN A. McCOLLUM

In the consideration of omnibus operation, it would be well to bear in mind that the use of this type of vehicle is not new in these cities. The omnibus was used in London and Paris, and also in New York, before the operation of mechanically propelled vehicles in city streets, but when horse cars, and subsequently, electric cars, were installed, the horse omnibus gave way in New York to the more efficient facilities, while it still continued in London and Paris to be one of the principal means of travel owing to the peculiar conditions there existing.

DEVELOPMENT OF THE OMNIBUS BUSINESS; PRESENT CONTROL

LONDON—The London General Omnibus Company, Ltd., now operates or controls the operation of about 95% of all the omnibuses in use in London. Only one other company—the National Steam Car Company, Ltd.—operates independently an appreciable number of cars.

The London General Omnibus Company, Ltd., is owned by the Underground Electric Railways Company, which company was organized to control or own a group of underground railway companies having a length of more than sixty miles and a capital of more than $180,000,000. During the development of the motor bus, it was foreseen by the Underground Railway interests that the motor bus would be a serious competitor of the Underground Railway. Because of this it apparently has been the policy to obtain control of omnibus companies operating in London through the London General Omnibus Company, Ltd., and thus prevent in some measure the direct effect of competition between underground and surface traffic.

Working agreements have been entered into with six other companies by which their omnibuses are operated by the London General Co., and with another company, known as the Thomas Tillings, Ltd., by which its operations are gov-

ened by an agreement with respect to the number of cars nd routes operated and the earnings therefrom, but not etually performed by the London General Company.

The growth of the motor omnibus is well illustrated by the number of vehicles licensed by the Police Department ach year since 1897. These figures show that the motor mnibus increased from 1 in 1897 to 3908 in 1912, while the horse omnibus decreased from 3190 in 1897 to 376 in 1912.

The daily average mileage of the horse omnibus is said to have been approximately 63, while the average mileage of a motor bus of the General Company is more than 110 miles per day.

PARIS—The first franchise for the operation of omnibuses was granted in 1854. The operation developed until the company had 961 horse omnibuses in operation in 1906. In June, 1906, the company began the operation of 13 motor busses on one line of a little less than four miles in length. These vehicles reduced the running time for the route by one-half, the schedule time for horse busses being one hour and for the motor busses thirty minutes. The experiments which were made subsequent to this time were so successful that in 1910, when the franchise of the Company expired, the renewal of the franchise provided that all lines should be equipped with mechanically propelled vehicles, and the franchise was so accepted by the company.

MAGNITUDE OF MOTOR-BUS BUSINESS, AND RECENT GROWTH

LONDON—The smaller of the two omnibus companies in London—that is, the National Steam Car Company, Ltd.—is operating at the present moment about 140 cars. Apparently no general public service is attempted by this company, but routes are operated in the more congested parts of the city, and only where a reasonable profit is insured. This company, however, claims to have a vehicle which is less expensive to operate than the vehicles used by its competitor and to have other features tending to attract the traveling public.

The London General Omnibus Company operates on weekdays 73 routes having a total length of 671 miles. These routes are varied somewhat for Sunday service, that is, some are withdrawn entirely, some are extended or altered, and nine routes are operated for a special Sunday service only. The number of vehicles in service on weekdays is about 2280, while on Sundays the number in operation exceeds this figure by more than 100.

The magnitude of the service covered by this company may be also illustrated by the fact that the territory worked includes the Metropolitan Police area (about 700 square miles), and two counties beyond this area. It includes 39 cities, counties or municipal boroughs, 45 urban districts and 11 rural districts; or in all the jurisdiction area of 95 local authorities. The total length of roadway worked in March of this year is given as follows:

	Weekday	Sunday
Within the County of London	216	211
Per cent. of total	62	51
Without the County of London	135	199
Per cent. of total	38	49
Total	351	410

The London General Omnibus Company employed in March, 1913, a total of 2750 omnibuses, or an increase of 219% over the number employed in 1910. The average daily number of passengers carried increased from 635,897 in 1910 to 1,588,822 in 1913, which is an increase of over 150%.

PARIS—There are at the present time in operation nearly 900 motor busses in Paris, about 50 of which are kept in reserve. Forty-seven different routes are operated, having a total length of about 165 miles. Practically all of the existing mechanically operated fleet has been put in service since the grant of the new franchise. The company did in 1910 operate some motor vehicles, but the existing type is a more recent one than that operated at that time. The last horse bus was removed from the streets in January of this year.

During this period of transformation from the horse to motor power the traffic figures are not such as can be considered as giving results of a normal operation. The number of passengers carried by mechanical and horse power vehicles during the last seven months of 1910, that is, the period immediately subsequent to the date of the new franchise, are as follows:

Motor bus	22,892,234
Horse bus	49,361,756
Total	72,253,990

Similar figures for the last six months of 1912 are:

Motor bus	85,550,890
Horse bus	14,292,958
Total	99,843,848

This shows not only the gradual change to motor-power vehicles but also illustrates the substantial increase in the number of passengers since the operation of the new type of vehicle.

RIGHTS TO OPERATE; HOW OBTAINED

LONDON—There is no law to prevent any company or individual from operating an omnibus for the purpose of conveying passengers for fare on streets within the Metropolitan police district, which district is considerably larger than London proper and having an area of about 700 square miles, provided a license therefor is obtained from the Commissioner of police. This license is granted almost as a matter of course for operation within the Metropolitan police area, providing the vehicle conforms with the fixed standard which has been adopted governing that class of public conveyance, details of which are hereafter referred to. No franchise whatever is required, and in this respect the conditions are wholly different from those of New York. It also differs in the method of obtaining rights to operate street railways or light railroads in London.

The method of obtaining franchises for street railways is difficult and expensive. The right is granted by Parliament and may be vetoed by the local borough authorities. To prevent this veto it is often necessary to contribute large sums toward the widening or improvement of streets in the borough where the right is sought. In view of the competition with the motor busses, this difference in the method of obtaining the right to occupy the streets is extremely important to the street-railway companies. After much difficulty and expense, such a company may obtain a franchise and begin its operations, only to share the traffic with any omnibus owner who finds sufficient traffic to yield a profit in its operations and who is not subject to expense of delay in obtaining street rights.

Outside the Metropolitan police area, the Borough Councils have power to refuse licenses for omnibuses, and this is occasionally done.

PARIS—The right of an omnibus or railway company to operate in the streets of Paris is granted by the City or State authorities.

The franchise under which the General Omnibus Company of Paris operates is a contract dated May 28, 1910, which gives that company the exclusive right to transport passengers by omnibuses within the walls of Paris. This same company has also the exclusive right to operate a system of street railways within the city walls.

TAXES AND OTHER PAYMENTS

OMNIBUS COMPANIES, LONDON—Taxes. There is a tax on all gasoline brought into England, amounting to approximately 6c. per gallon. Omnibus companies, since they operate public conveyances, obtain a rebate equal to one-half of the tax. The net tax therefore is 3c. per gallon upon all the gasoline used as fuel. Computing the amount on the basis of 100 miles as the distance traveled per omnibus per day, 7½ miles as distance traveled per gallon, and assuming that the vehicle is in operation 310 days per year, the tax would amount to about $136 per year. These figures are approximate only, but are probably lower than the actual. The amount of this tax has been officially reported to be as high as $210 per omnibus per annum.

RAILWAY AND TRAMWAY COMPANIES, LONDON

PERMANENT WAY TAX—Tax rates are paid on property which it owns. Licenses cost per annum about $10 per car. The tax on permanent way amounted during the year ending March 31, 1913, to about 4.4% upon the passenger traffic revenue of the London County tramways. Street railways are required to keep in repair the area between lines 18 in. on each side of outer rail. The franchises under which the London County tramways are operated provide in some cases that an appropriation shall be made from the earnings of the operation of the railway toward the improvement of streets (that is, straightening, widening, etc.), in which the railway is to be operated. The sum so appropriated during the year ending March 31, 1913, was about $350,000, and the total sum expended by the London County Council up to March 31, 1913, was nearly $3,000,000.

OMNIBUS COMPANIES, PARIS

The franchise requires that the following payments be made: (a) 3½ per cent. of the gross receipts from passengers up to $5,770,000. If the receipts exceed that sum, the company must pay 4 per cent. on the amount in excess. These payments are to be reduced one-half for certain optional lines which the company may establish. The franchise to the General Omnibus Company for its street surface railway requires the payment of 6 per cent. of the gross receipts from passengers received within the city walls. There is also a tax

in Paris, taken at the city gates, which applies to fuel used in the operation of omnibuses. This city tax upon benzol, the fuel now used, is approximately 10½ cents a gallon, which amounts to about 2.3 cents per omnibus mile. If the company were required to pay this tax upon all the fuel which it uses, the income to the city therefrom, using the mileage operated by motor busses during the last six months of 1912 as the basis of computation, would be about $170,000 per annum.

EFFECT OF MOTOR-BUS OPERATION UPON THE EARNINGS OF STREET SURFACE RAILWAYS

LONDON—All except a few short lengths of street surface railway within the County of London, which county includes by far the greater part of London, are owned by the County and operated by the London County Council. These railways are known as the London County Tramways.

The Council now operates railways as follows:

	Street Miles
Electric underground contact	117
Electric overhead contact	24
Horse	7
Total	148

The average number of cars operated during the year ending March 31, 1913, which is the fiscal year, was:

Electric	1237
Horse	38
Total	1275

The electric cars are in nearly all cases double deck and have a capacity of from 62 to 78 passengers. The modern cars which are being standardized have a capacity of 78 passengers.

The capital employed up to March 31, 1913, was about $63,000,000. Sinking Funds, however, have been provided, amounting to nearly $10,000,000.

The tramways are seriously handicapped by being unable to deliver their passengers within the dense business area of the city. No tramways are allowed, nor are they likely to be allowed, within the large central business area of London, where a large majority of the streets are short, narrow and crooked, it being maintained that the omnibus is better adapted to operate in this congested portion of the city than is the tramway. Since the tramway, therefore, cannot enter this district, it must discharge passengers whose destination is within the district at the boundary thereof. There is no doubt that tramway traffic would be greatly increased if its lines could be extended into the heart of the city. The motor bus, on the other hand, has the exclusive right on the surface within this central area, but is not prohibited from operating in the territory of the tramways and is thereby able to give a more complete service than the tramway.

This rapidly increasing number of omnibuses and the paralleling of railway routes has had a decided effect on the earnings of the railway. In London omnibuses are popular as a means of travel; have a monopoly of the best traffic districts of the city with no district limit of operation; charge a slightly higher fare than the street railways; do not furnish all night service; contribute nothing toward paving maintenance or street improvements; require small capital account in comparison with earnings, and can operate profitably on a small margin above operating cost. Because of this they are severe competitors of the tramways, and I believe that their continued competition under these conditions will work disastrous results to the tramways. The safety of the situation seems to lie in regulation or restriction of the routes of omnibuses, which at the present moment seems unlikely to occur, or the control of both tramways and omnibuses by the same interests, thus eliminating competitive operation.

PARIS—There is no competition between the surface railways and the omnibuses in Paris. The reason for this is that the omnibus operation and the operation of practically all of the street surface railways within the omnibus district are controlled by the same company and routes of both systems have been laid out by the authorities with consideration given to the work to be performed by each. The franchises fix the rate of fare and the routes upon which both railways and omnibuses may operate, and permit a readjustment of fares for both railway and omnibus service when conditions are such that either system is not profitable. Both systems are operated by one company under exclusive rights; each supplements the other and the two may be considered as one system.

EFECT OF OMNIBUS TRAFFIC UPON STREET PAVEMENT

LONDON—Unfortunately, the jurisdiction of the construction and repair of roads in London does not lie in one body. Each Borough Council has this authority for its respective borough and each has its own engineer and the necessary force for carrying out the work. The "Metropolitan Committee on Materials and Means of Paving the Streets of London," which is made up of representatives from each council, invited, this year, an expression of opinion of the surveyors of the various Metropolitan boroughs as to whether the increase of motor traffic has the effect of increasing the cost of paving and maintaining roads in their respective boroughs. All of the surveyors who expressed themselves in regard to the subject agree that omnibus and heavy motor traffic on macadam roads resulted in wear which caused a large increased cost of maintenance and replacement. Nearly all agreed that greater weight of vehicle with its increased speed has caused the breaking up of foundations which were formerly laid to carry a lighter traffic. The foundations for new work and replacement have been considerably increased in thickness over that used in former practice, the increase being due to more and heavier motor traffic.

PARIS—The condition of the surface of Paris pavements is by no means as good as that in London. Very little information could be gained relative to the effect of omnibus traffic upon street pavements. A thorough investigation, however, is now being made into this subject by the Inspector General of Services in Public Streets, and his report will soon be issued.

MOTOR OMNIBUSES—TYPES IN USE

LONDON—There are three distinct types of vehicle in use in London—

First—Those operated directly by gasoline engine (used by the London General Omnibus Company);

Second—Those operated by steam, with kerosene oil as fuel (used by the National Steam Car Company);

Third—Those operated by gasoline engine driving a dynamo, operating an electric motor which drives the rear axle by means of a worm gear (used by Thomas Tillings).

Two types have been developed by the London General Company, one known as the "B" type, of 30 hp., and the other known as the Daimler type, of 40 hp. It is the intention of the Company to make all new vehicles 40 hp. The other specifications of the two types are very similar. Both are lighted by gas.

The car used by the National Steam Car Co. is 32 hp. and it is lighted by a special self-contained electric-lighting equipment, consisting of a small dynamo, situated on the seat beside the driver, which is directly operated by the engine and furnishes current for incandescent electric lamps.

It is claimed for both the steam car and the gasoline electric car that they are particularly easy to operate and are more comfortable for passengers than the gasoline vehicle because of the absence of the jerk and jar in starting. From my experience in riding upon the various types of vehicles, I am inclined to believe that this claim has considerable foundation.

PARIS—Four types of motor busses are in use in Paris. The estimated number required to place the full system in operation, the capacity, the horsepower and speed are given as follows:

Type	Estimated Number	Passenger Capacity	Horse-power	Maximum Speed Per Hour
Schneider	518	35	35	About 15 miles
Schneider	109	35	35	About 15 miles
Dion-Bouton	263	31	35	About 12½ miles
Schneider	100	30	35	About 15 miles

The horsepower rating as used in London and Paris is not the same as that used in America and therefore comparisons should not be drawn until brought to the same standard.

These vehicles are all single deck, the first-class passengers being provided with seats in the forward part of the car, and the second-class passengers in the rear part, with both seating and limited standing space on the platform. The entrance to all vehicles is by means of steps on the rear of the platform and door at the rear of the car.

[*To be continued in next week's issue*]

The Utilization of Water for the improvement of land not only by direct application in irrigation but also by utilizing water power to produce nitrates for fertilization is being practiced to a small extent in Europe. In both Germany and Norway there are water-power plants manufacturing nitric acid and nitrates for agricultural use, and Lord Kitchener has proposed that 15,000 hp. should be developed at the great Assouan Dam, in Egypt, and applied to nitrate production for improving the Egyptian soil. In this country one indirect step has been taken toward the same end. A franchise granted for power development on the Pond d'Oreille river, in Idaho, provides that when the company utilizes the power for nitrogen production, its payments to the government shall be reduced.

Plans for the New Buildings of the Massachusetts Institute of Technology

Plans for the development of the new site of the Massachusetts Institute of Technology on the Charles River Basin, Cambridge, Mass., were recently presented to the Alumni Council by the President, R. C. Maclaurin. This is the first publication of plans to men outside of the Institute corporation. Dr. Maclaurin, in his remarks, explained the efficiency in instruction and economy in construction of the continuous group of educational buildings which has been employed, and the large provisions for expansion of those departments whose future needs could not be well foreseen. He also advised the alumni that the new buildings would not resemble either a factory group or a series of skyscrapers. While the walls, as structures, would be of reinforced concrete, yet this would not be exposed, as it was felt that the material then would not be permanently satisfactory. The facings of the facades will be Indiana limestone and light brick will be used in the interior courts.

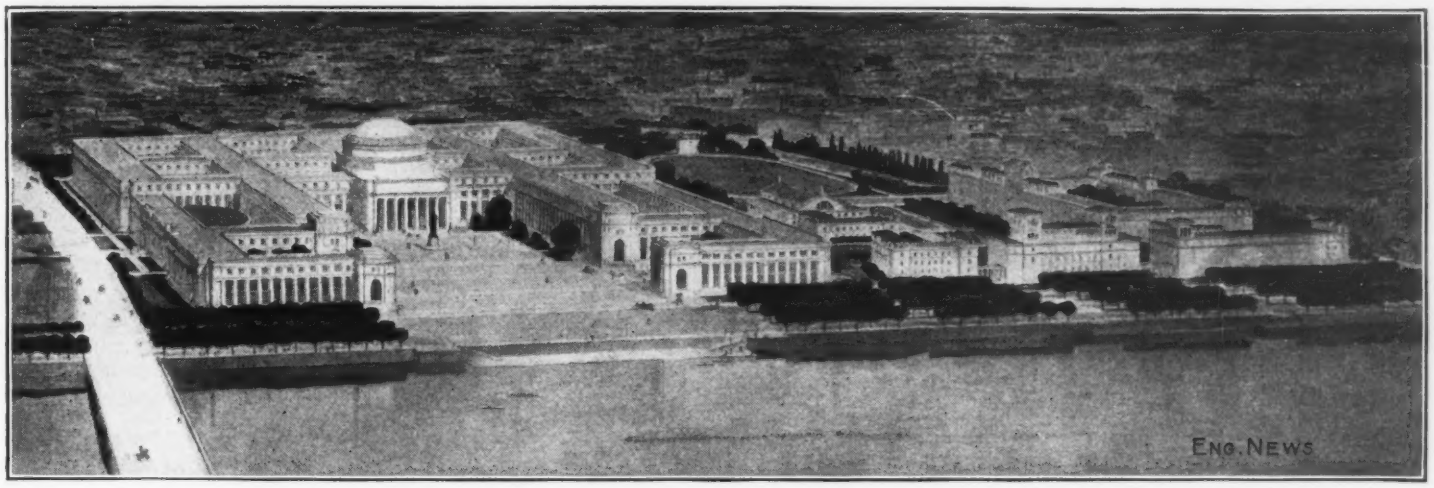


FIG. 1. PERSPECTIVE OF THE NEW BUILDINGS OF MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Since the 50th anniversary of the founding of the Institute, in April, 1911, some $7,350,000 have been raised for the purchase of the land and the development of the new buildings. It will be remembered that this started with $500,000 from T. C. Dupont for land; conspicuous among the remaining amount is $3,140,000, the donors of which remain anonymous, $1,000,000 from the State of Massachusetts for maintenance, and an endowment of $750,000 from the late C. H. Pratt, of Boston, for a school of naval architecture.

The accompanying figures show the general arrangements of the plant and a few architect's sketches of individual buildings. The grounds, extending 1500 ft. along the Charles River and about the same on Massachusetts Ave., have been cut squarely in two. The eastern half is allotted to those buildings for the out-of-school life and activities of students. On the western half is placed the educational group, which is virtually a single structure. The Cambridge subway runs near the northeast corner of the grounds, with the Kendall Sq. station close by, affording quick service from Boston.

EDUCATIONAL BUILDINGS—The several sections are clustered about the library which has been made the central feature, with its Roman dome 200 ft. high, rising above a pillared portico. The central court in front of the library is open to the river front and expands near the esplanade to two minor courts. Shrubs, grass plots and fountains are to be used to relieve the severity of the clustered structures; trees are designed to accentuate the corners. The architecture is classical, with pilastered walls, permitting the recesses to be largely of glass. The long facades near the river will have pilasters two stories high and the third story forming the frieze. On buildings farther back a fourth or attic story is added above the entablature. Thus the group rises in height from front to rear. The detail treatment planned is very simple, beauty being sought in magnitude and proportion rather than by ornament. The departmental structures join one another so that it will be unnecessary to go outdoors in passing from one to another. By the use of interior courts, long and narrow wings result, receiving light from both sides.

In planning these buildings the heads of departments were asked to prepare figures for what each one would wish if there were no other departments to be considered; these figures, harmonized, were used in fixing the space requirements for study rooms, lecture halls, laboratories, drafting rooms, etc. Shortly after the site was secured, came the generous offer of John R. Freeman, of Providence, an alumnus, to make a full investigation of the engineering problems of such an undertaking and a study of the conditions, equipment and fitness of existing college structures. His assistants examined every recent building for special use in American colleges, while the president and members of the faculty spent their summer vacations in Europe on similar investigations. Mr. Freeman analyzed and reduced all these reports and finally outlined the best solution of the different problems defining his own idea of what form the development should take, discussing the lighting, heating, ventilation, drainage, materials, etc. The single structure type which has been employed was suggested by him, although its final form is not the same.

Prof. W. O. Crosby made an exhaustive study of the bearing qualities of the soil and the nature of the subsoil. Numerous borings were made and heavy load tests have determined coefficients of sinking, etc. Finally, eight months ago, W. W. Bosworth, of New York, also an alumnus, was selected as the architect with Prof. J. K. Taylor, head of the Architectural Department (formerly Supervising Architect of the U. S. Treasury De-

partment) as consulting architect. The construction of the buildings has been put in the hands of the Stone & Webster Engineering Corporation of Boston (whose officers are largely alumni). From all this it is evident that the "new Technology" has been planned and will be built by its own graduates.

The distribution of floor space in the general plans has been made approximately as follows:

	Sq.Ft.
Architecture	62,000
Chemistry	70,000
Civil engineering	42,000
Electrical engineering	50,000
General studies	52,000
Library and administration	30,000
Mechanical engineering	176,000
Mining and geology	77,000
Naval architecture	35,000
Physics	55,000
Public health and sanitation	41,000

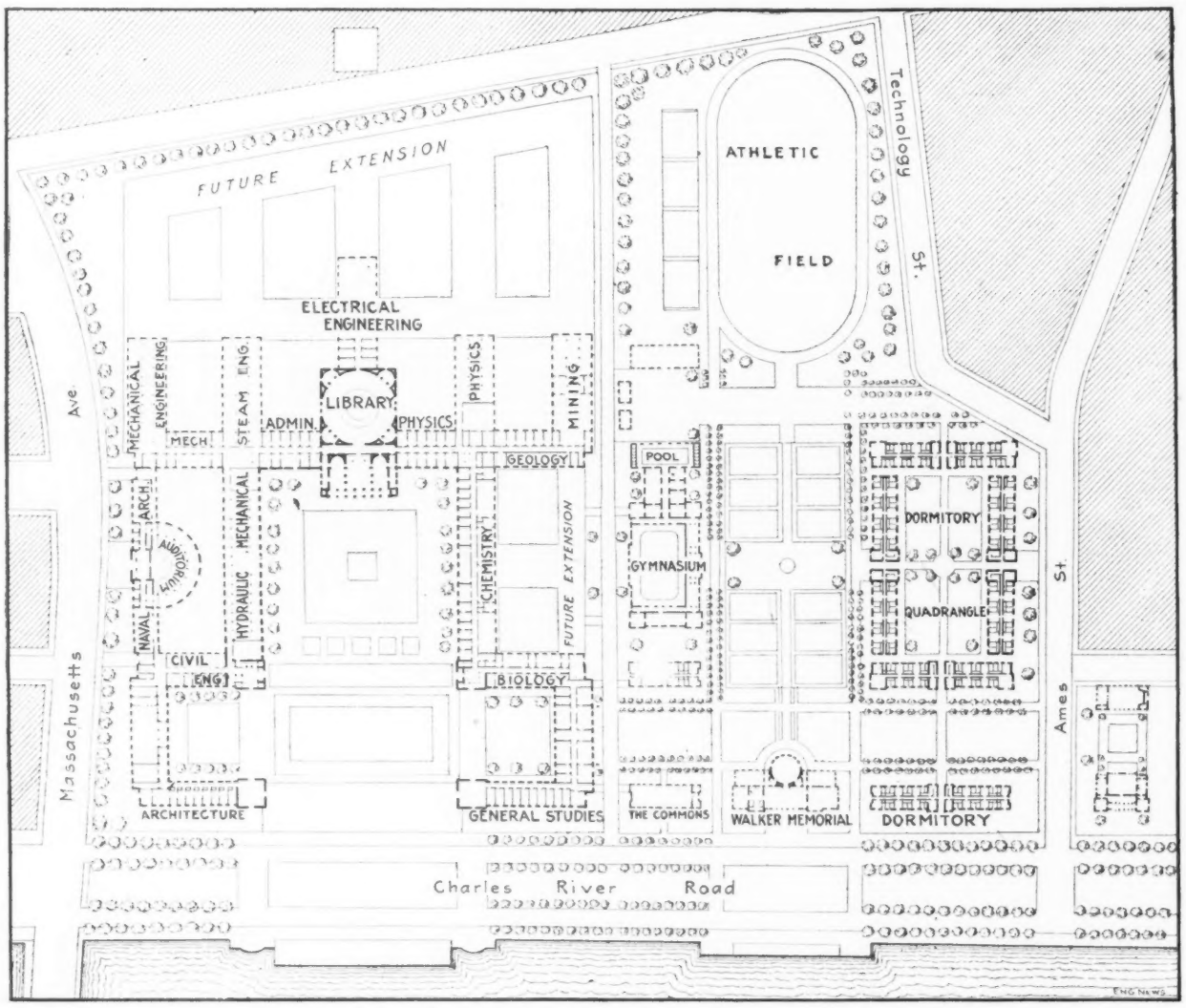


FIG. 2. PLAN OF BUILDINGS AND GROUNDS OF MASSACHUSETTS INSTITUTE OF TECHNOLOGY ON THE CHARLES RIVER BASIN, BOSTON

These areas do not include the basements. The aggregate floor space will be about 45,000,000 sq.ft. A student entering one wing and traversing the buildings once will have walked nearly a mile. The several floors, if placed end to end, would make a way five miles long and 40 to 60 ft. wide.

In planning the position of the several departments, recourse was made to familiar circle diagrams showing the percentage distribution of time to various subjects in the several courses. For instance, a diagram for the course in electrical engineering shows for the first year that half the time is devoted to mathematics and chemistry with the rest in general studies; for the remaining three years the predominant time factors are physics, and electrical and mechanical engineering. On the general plan, Fig. 2, it is seen that general studies and chemistry are housed close together in front of the library, while the electrical-engineering building is just back of it with mechanical-engineering laboratories on one side and physics on the other. Reasons for other arrangements are generally apparent.

It is seen that the technical departments converge on the library so far as possible, an arrangement which has been adopted to keep the special libraries of these departments close by the departmental buildings but yet under the care of the library force.

All the buildings in interior arrangement are a system of bays of uniform size. The floors will be hung on the walls independently of all partitions. Rooms can easily be rearranged in any multiple of the base unit by removing partitions. It is hoped in this way to let each department adapt its rooms to its needs instead of being handicapped by structural limitations. Besides expanding into adjacent rooms, any department may grow, without disarranging other departments, by new extensions on space distributed for that purpose. In many cases two and three possible directions of expansion are open.

There will be about 2½ acres of drafting rooms, comprising the top floor of all departments except chemistry and general studies. The roofs over these rooms will be broken by standard saw-tooth skylights running across

the narrow width of the longer buildings and giving northern exposure but hidden from view below by the high parapets.

The Pratt School of Navel Architecture and Marine Engineering is to occupy the most prominent land position—at the center of the Massachusetts Ave. facade, as one of the conditions of the Pratt bequest was that the school should have a suitable memorial building. Only the general features of this structure have been developed as actual construction must wait a year or two until other conditions have been fulfilled. It has been decided, however, that the school shall have its own entrance from the street; in the basement is to be a towing tank for ship models.

The largest auditorium, seating 2000, is placed within the interior court behind the Pratt School. Parallel with the latter is the mechanical-engineering department, with its heavy laboratories toward railroad tracks in the rear. Back here also is the power plant, of 4000-hp. capacity.

At the right of the library are the administration offices, the Registrar and Bursar on the first floor and the President and other officers above. Physics occupies a corresponding wing on the left. On the east of the main court are quarters for the general studies and biology.

FIG. 3. TYPICAL ARCHITECT'S PERSPECTIVE SKETCHES OF NEW TECHNOLOGY BUILDINGS

(Court in front of General Studies Building and the Pratt School of Naval Architecture.)

of these only biology has extensive room for expansion (under this department will be the public-health work, which it is expected greatly to develop). Chemistry is located farther back and mining and metallurgy has the northeast corner of the group.

STUDENTS' BUILDINGS—As already noted, half the property has been assigned to buildings for student activities, and these will be kept quite distinct from the instructional group. The greatest defect of the "old Technology" undoubtedly has been the lack of dormitories and facilities for social life, due to its location in the congested Back Bay district of Boston.

The principal feature of the student group, architecturally, will be the Walker Memorial (in memory of the late Gen. F. A. Walker, former President of the Institute). This building is to face the river in the center of the frontage allotted to the student group. Near-by and connected by a covered gallery will be the "Commons"—a dining hall for students and faculty. The special committee on the Walker Memorial project has recommended a huge living room of 4000 ft. area opening upon a terrace from which Boston is seen across the Charles River Basin. There is planned a small auditorium, and quarters and committee rooms for the school papers and associations, some 30 in all. A special fund for the erection of the Walker Memorial has been accumulating for several years, and it now aggregates $200,000. However, work will not be started on this project immediately as it is felt that the construction of the educational buildings alone is a large enough undertaking sufficiently to tax the ability of all interested. Moreover, funds are not yet available for the gymnasium and dormitories.

A gymnasium is planned to cost about $100,000, and to have a single floor of 15,000 sq.ft. area and a total floor area of 40,000 sq.ft. At the rear of the grounds is provided space for an athletic field with running tracks and grandstand.

Four dormitories are planned to form a quadrangle, while a fifth faces the river. The arrangements for these buildings are based immediately on the studies of existing college structures by John R. Freeman, as mentioned before. They will be arranged on what may be called the "staircase system" where comparatively small groups of students have access to their rooms through the same entry. This eliminates long corridors and the hotel-like arrangement where there are too many men in contact for any to become well acquainted. The plans provide for sleeping porches and plenty of baths.

NOTES

The First Vessel Through the Panama Canal was the small steamer "Louise," which on the afternoon of Nov. 17, passed entirely across the isthmus with a party of the canal officials and their ladies. The trip was made possible by the cutting of a channel by the dredges through the famous Cucaracha slide in Culebra cut, the last obstruction to free communication between the two oceans.

Inauguration of the Hales Bar Dam occurred on Nov. 13, 1913, with a celebration by the Chattanooga (Tenn.) Chamber of Commerce, which a large visiting party from New York and elsewhere attended. The powerhouse machinery was started through the turning of switches by two granddaughters of the late Anthony N. Brady. Mr. Brady supplied the money for the Hales Bar work, and his faith in the enterprise persisted in spite of the failure of three successive contractors to overcome the difficulties of the work. Nicholas F. Brady and James C. Brady, his sons, who were closely associated with him in the matter and continued the work after his death, attended the inauguration.

A Fire, Following an Explosion in a tank containing 30,000 bbl. of crude oil, at an oil works owned by the Standard Oil Co., at N. 13th St. and Kent. Ave., Brooklyn, N. Y., on Nov. 12, was extinguished by the use of a steam system, according to press dispatches.

A 60-Ft. Span Collapsed, in the wooden trestle over the Pamunkey River, on the West Point Division of the Southern Ry., near Richmond, Va., on Nov. 3rd, under the weight of a train. The engine, tender and three freight cars fell into 30 ft. of water. One man was killed and three others were injured.

A Wreck on the Central of Georgia Ry., on Nov. 13, 17 mi. south of Eufaula, Ala., in which three wooden passenger cars plunged down a 30-ft. embankment, caused the death of 15 persons and the injury of about 100 others. A defective rail, according to press dispatches, is said to have caused the accident.

The Damage to the Pioneer Station in Ogden, Utah, which, as noted in "Engineering News," Nov. 13, 1913, was flooded by accidental opening of a turbine control valve is now authentically reported to be comparatively small. The electrical apparatus had to be dried out, but aside from that was found little injured. The damage to building and pipe line was not serious.

A Stand Collapsed on the De Pauw University athletic field, at Green Castle, Ind., on Nov. 1, during a football game. About 100 of the 700 spectators in the stand were injured. This accident is similar to that which occurred at Tulsa, Okla., on Oct. 28, when a stand collapsed during a baseball game, and 100 persons were injured ("Eng. News," Nov. 6, p. 946.)

The Severe Storm of Nov. 11, which swept from the western end of Lake Superior to the western shore of Lake Erie, did enormous damage to shipping on the Great Lakes. On Nov. 14 a summary of casualties showed that 13 vessels carrying 251 persons had been lost and 70 small lake vessels, carrying from 2 to 7 persons each, were missing.

An 8000-R.p.m. Turbine-Driven Pump was announced by Carl G. de Laval, General Manager of the Henry R. Worthington Hydraulic Works, at the American Society of Mechanical Engineers' meeting, in New York City, on Nov. 11. It is claimed that this pump, operating at speeds varying from 7500 to 8500 r.p.m., forces 400 to 500 gal. of water per minute through a 4-in. discharge pipe, against a pressure of 300 to 350 lb. per sq.in., at 56 to 68% efficiency. This pump is built for service where space is limited.

A Condensed Description of the Panama Canal and its construction is given in the "Official Handbook," compiled by Joseph Bucklin Bishop, Secretary of the Isthmian Canal Commission. The fourth edition, after a final revision, has just been published. The handbook is a pamphlet of 61 pages with a map and numerous illustrations, and gives the principal facts regarding the canal that are most often called for by inquirers. Copies of the book can be obtained on request, we believe, by addressing either the Commission headquarters at Panama or at Washington.

Completion of the Last Panama Canal Lock Gate—The last of the 92 leaves for the miter gates of the canal locks was lowered into place on its hinge pintle on Oct. 30. This was the side wall leaf of the lower operating gate in the east flight at Miraflores Locks. The lower operating gates at Miraflores are the largest in the canal construction, each of the lower leaves being 82 ft. high and weighing over 700 tons. The work of lining up and babbitting the nickel-steel bearing plates at both ends of a leaf can be completed only after the leaf is swinging in operating position, and the leaves are yet to be tested, painted inside and out, and fitted with footwalk and handrail. ["Canal Record."]

Are Horses' Feet Harmed by Concrete Paving?—One of the main contentions against the use of concrete pavement is that it is very hard on horses' feet, and statements have been made at times that veterinaries in districts where concrete paving is prevalent have noted a pronounced increase in the number of horses treated for sore and damaged feet. The Common Council of Hartford, Conn., has just passed an ordinance requiring that stable floors in the city be made of concrete, and in opposition to this ordinance the statements noted above have been brought forward. Any of our readers who have had experience in this matter, would help the investigation if they forwarded the results of their experience to the Aberthaw Construction Co., of Boston, Mass., which is studying this question and proposes to compile a symposium of views from all parts of the country.

The United States Good Roads Association Convention in St. Louis, Nov. 10-14, brought together not over 200 people. The sessions were held in a deserted summer garden, nearly an hour distant from the center of the city, so inconveniently located that no delegate attended more than one or two sessions. The place was chosen because facilities were there available for an exhibit of road machinery, but the attendance must have been disappointing to the exhibitors. The purpose of the Association and of the Convention was to induce the Federal Government to make appropriations in aid of good roads construction, and the Bankhead bill, appropriating $25,000,000 annually for the purpose, was indorsed. A committee was also appointed to negotiate for the consolidation of the seven existing national associations for promoting good roads. The next meeting is to be held at Tulsa, Oklahoma.

Preliminary Inspection of New York State Roads by New Division Engineers—John N. Carlisle, Commissioner of Highways of New York State, has directed the new division engineers (see "Engineering News," Oct. 23, p. 843) to go carefully over the roads which are to be constructed next year so that the plans and estimates may be revised in time for the first letting which will take place as soon as the highway specifications now under preparation are adopted. The last public hearing on the specifications was held Nov. 17. It is proposed to receive bids on from 30 to 40 roads each week until all the roads to be constructed next year are under contract. By having weekly lettings instead of having a large number of roads advertised for one letting, it is expected there will be a more even distribution of contracts among the contractors, so that no one man or firm will get more roads than can be taken care of; and it is believed that this will also result in lower prices. These contracts will all be let so that the material can be on the road this winter and the construction work can begin as soon as the frost is out of the ground in the spring.

New 15-Cu.Yd. Dipper Dredges for the Panama Canal—The "Gamboa," the first of the two 15-cu.yd. dipper dredges contracted for by the Isthmian Canal Commission early in 1913 for work in Culebra cut, was launched recently at Newburg, N. Y. In accordance with the terms of contract with the builders, the Bucyrus Co., of South Milwaukee, Wis., one of these dredges must be delivered at an Atlantic port on or before Dec. 1, 1913, and the other on or before Jan. 1, 1914. It is planned to take the "Gamboa" to New York City about Dec. 1, and to bring it to the Atlantic entrance of the canal in tow of a seagoing tug. The second dredge will be named the "Paraiso." A penalty of $100 per day is provided for each day the contractor overruns the time of delivery, and a like premium for him for every day that he anticipates in delivery. The price agreed upon is $258,500 each. The dredges are to be equipped with 16x28x24-in. twin tandem compound main hoisting engines, with single part wire-rope hoists and steel hulls. They will dig to a depth of 50 ft. below the water level. The machinery throughout is constructed to withstand the maximum pull of the engines when working under a 125-lb. steam pressure at the engine and condensing. Similar dredges were built by the Bucyrus Co. in 1910, for dredging in Boston harbor. ["Canal Record."]

The Chicago Elevated Railways have at last put in operation a through route system of operating trains and a free transfer system between the different lines, for which the city authorities and the public have been making demand ever since the four companies came under one ownership. Hitherto every train on the terminal loop has passed around the four sides of the loop, entering and leaving at the same points. Passengers transferring from one line to another had to pay a second fare.

Beginning Nov. 3, through trains were put in operation between the north and south sections of the city. The junctions are at the northwest and southeast corners, and under the present arrangement the southbound trains will run on the north and east sides of the loop, while the southbound trains use the south and west sides. Only a certain proportion of the trains will be through trains. The trains of the two west-side elevated railways, connecting at the northwest and southwest corners of the loop will continue to pass around the loop, as will the "loop" trains of the north-side and south-side lines. Under the new arrangement, the two west-side lines will use the inner track of the loop, and the north- and south-side lines will use the outer track, but the trains on both tracks will run in the same direction, while formerly they ran in opposite directions. Free transfer will be permitted between the trains of the four lines, and bridges over the tracks have been erected at four of the eleven stations on the loop, so that passengers can cross from one platform to another without going through the stations.

PERSONALS

Mr. A. H. Foreman has been appointed Assistant Professor of electrical and experimental engineering at West Virginia University.

Mr. F. H. Burnette announces that he has opened offices at 716 Traction Terminal Bldg., Indianapolis, Ind., for the general practice of civil engineering.

Mr. Russel G. Swan, recently with the Vancouver Power Co., Ltd., Lake Buntzen, B. C., has been appointed Chief Engineer of the Hydrographic Survey of British Columbia.

Mr. B. A. Porter has been promoted from the position of Trainmaster of the Yazoo & Mississippi Valley R.R. at Memphis, Tenn., to be Superintendent of the Memphis division, succeeding Mr. P. Laden, resigned.

Mr. J. D. Stack, former Division Superintendent of the Oregon-Washington R.R. & Navigation Co., is now Assistant Superintendent of the Toledo division of the Cincinnati, Hamilton & Dayton Ry., at Dayton, Ohio.

Mr. W. G. Curran has been appointed Assistant General Superintendent of Transportation of the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton Rys., with headquarters at Cincinnati, Ohio.

Mr. C. Nesbitt Duffy, recently Comptroller of the Milwaukee Electric Ry. & Light Co., Milwaukee, Wis., has been elected Vice-President and General Manager of the Manila Electric R.R. & Light Co., Manila, P. I.

Mr. R. F. Russell, formerly with the engineering staff of the automobile department of the American Locomotive Co., Providence, R. I., has joined the engineering staff of the Bessemer Gas Engine Works, Grove City, Penn.

Mr. Ira L. Craig, Assoc. Am. Inst. E. E., has resigned as Superintendent of the electric department of the Citizens Gas & Electric Co., Waterloo, Iowa, to become Electrical Engineer of the American Gas Co., Philadelphia, Penn.

Mr. Arthur B. DuBray, recently Inspector of electric signals, St. Louis & San Francisco R.R., at Springfield, Mo., has been appointed Railway Signal Engineer of the Missouri State Public Service Commission at a salary of $2400 per annum.

Mr. J. Waldo Smith, M. Am. Soc. C. E., Chief Engineer of the Board of Water Supply, City of New York, sailed from New York on Nov. 12 for a visit to the Panama Canal as the guest of Mr. John Purroy Mitchel, Mayor-elect of New York City.

Mr. Phillip P. Bourne has been appointed Chief Engineer of the Epping-Carpenter Pump Co., Pittsburgh, Penn. Mr. Bourne has been for the past eight years Chief of the engineering staff of the Blake-Knowles Steam Pump Works, East Cambridge, Mass.

Mr. A. L. Dierstein, recently with the bridge department of the Chicago, Milwaukee & St. Paul Ry., has been appointed Instructor in structural engineering at Purdue University. Mr. Dierstein graduated from the University of Colorado in civil engineering in 1911.

Mr. James Clifford, whose resignation as District Engineer of the Illinois Central R.R. at Chicago, Ill., was noted in our issue of last week, has been appointed Assistant Engineer of Maintenance-of-way of the Canadian Pacific Ry., Western Lines, at Winnipeg, Man.

Mr. S. M. Bate, recently Resident Engineer of the Beaumont, Sour Lake & Western R.R., at Houston, Tex., and Division Engineer of the New Orleans, Texas & Mexico R.R., has been promoted to be Division Engineer of both railways, with headquarters at De Quincy, La.

Mr. D. W. Thrower, Assistant Engineer of Maintenance-of-way of the Illinois Central R.R., Chicago, Ill., has been promoted to be District Engineer of the Yazoo & Mississippi Valley R.R., at Memphis, Tenn., succeeding Mr. August F. Blaess, promoted as noted in our issue of last week.

Mr. Arthur L. Webster, of Wheaton, Ill., has been appointed Highway Engineer of Du Page County, Ill., under the new Illinois law providing for county engineers in charge of road work. The appointment was made on the basis of a competitive civil-service examination, and is for a term of years.

Mr. George Nash, former General Superintendent, has been promoted to be General Manager of the Pittsburgh Steel Co., Pittsburgh, Penn. He is succeeded as General Superintendent by his former Assistant, Mr. C. J. Morgan. For 11 years Mr. Morgan was Assistant General Superintendent at Glassport, Penn.

Mr. C. Willis Adams, former Superintendent of the Philadelphia works of the Link-Belt Co., is now Assistant to the President with headquarters at the general offices of the company in Chicago, Ill. He is succeeded as Superintendent at Philadelphia by Mr. Frank Oakes, formerly General Shop Foreman of the Chicago works.

Mr. Henry B. Smith, Jun. Am. Soc. C. E., of Oakland, Calif., has been appointed Instructor in railway engineering at Purdue University. Mr. Smith is a graduate in civil engineering of the University of Virginia, class of 1909, and has had experience with the Isthmian Canal Commission and as an instructor at the University of Iowa.

Mr. John H. Armstrong, M. Can. Soc. C. E., Chief Engineer of the Hudson Bay Ry., has resigned, according to a newspaper dispatch in the Toronto "Globe." Mr. Armstrong has been in charge of the project since 1908, and it is upon his reports and upon surveys made under his supervision that the route to Hudson Bay has been selected.

Mr. George J. Gould has resigned as President of the Manhattan Ry. Co., New York City. The Manhattan Ry. Co. owns and formerly operated the elevated lines of the Borough of Manhattan; it was leased in 1902 to the Interborough Rapid Transit Co. for 999 years. Mr. Gould is succeeded as President by Mr. Edgar L. Marston, a New York banker.

Mr. John Calder, M. Am. Soc. M. E., has resigned as President of the International Motor Co., New York City. Mr. Calder was formerly Manager of the Remington Typewriter Works at Ilion, N. Y., and later was connected with the Cadillac Motor Co., of Detroit. He is succeeded as President of the International Motor Co. by Mr. Vernon Monroe, former Secretary.

Mr. M. H. Cahill, Assistant Superintendent of the Cumberland division of the Baltimore & Ohio R.R., at Keyser, W. Va., has been promoted to be Superintendent of the New Castle division, at New Castle Junction, Penn., succeeding Mr. H. H. Temple, resigned. Mr. Cahill was formerly Superintendent of the Delaware, Lackawanna & Western R.R. at Buffalo, N. Y.

Mr. R. W. Hawley, Assistant Hydraulic Engineer of the California Railroad Commission, has been promoted to be Hydraulic Engineer. Mr. Hawley graduated from the Colorado State College in 1896. Practically his whole experience has been in water-power and irrigation work in the West. For several years he was with the United States Reclamation Service, and he was in charge of work on the Truckee-Carson Project in Nevada in 1905 and 1906. Later he was Superintendent of Irrigation of the Umatilla Project in Oregon.

Mr. Charles H. Sweetser, M. Am. Soc. C. E., former Consulting Engineer of Olympia, Wash., Senior Highway Engineer of the United States Office of Public Roads since last July, has been granted leave of absence from his governmental duties in order to prepare plans and supervise construction of road improvements in Calcasieu Parish, La., to cost $900,000. Mr. Sweetser was educated at the Massachusetts Institute of Technology and at Leland Stanford, Jr., University in California. He has had an extensive experience in public works engineering in Cuba and Hawaii and was Supervising Engineer of the Washington State Highway Department 1907-'09 and Chief Engineer 1909-'11.

OBITUARY

Mrs. George W. Jackson, wife of Mr. George W. Jackson, Engineer and Contractor, of Chicago, Ill., died at the family home in Chicago, Nov. 11.

Arthur J. Frith, M. Am. Soc. M. E., Associate Professor of mechanical engineering at the Armour Institute of Technology, died at his home in Chicago, Ill., Nov. 10.

Carl M. Starkey, Chief Engineer of the H. E. Talbott Co., Engineers and Contractors, Dayton, Ohio, died Nov. 12, at the Royal Victoria Hospital, Montreal, Que., from typhoid fever. He had recently been at Grand Mere, Que., where the H. E. Talbott Co. is constructing an 180,000-hp. hydroelectric power plant for the Laurentide Co., and while on this work contracted a severe case of typhoid fever. He was removed to Montreal but died in about two weeks.

C. Russell Hewlett, Dean of the School of Applied Design of the Carnegie Institute of Technology, died from pneumonia, Nov. 6, at the West Pennsylvania Hospital in Pittsburgh. He was born in Brooklyn, N. Y., Oct. 30, 1872. He graduated from Columbia University, New York City, and studied architecture in Paris, France. Returning to this country he became a member of the firm of Lord & Hewlett, Architects, New York City. Mr. Hewlett became a member of the faculty of the Carnegie Institute of Technology in 1908.

James Melville Robertson, Assoc. M. Inst. C. E., Assoc. M. Can. Soc. C. E., was accidently killed by the discharge of a rifle at Sylvan Lake, Alberta, Canada, on Sept. 14. He was 27 years old and the only son of James Robertson, of Bonneybridge, Stirlingshire, Scotland. He received his earlier education and training for the engineering profession in Glasgow, Scotland. He was a graduate of the Glasgow West of Scotland Technical College, and afterward a pupil of Messrs. Wharrie & Colledge, Civil Engineers, Glasgow. His experience subsequently had been principally on Canadian railways. By his great zeal for his work and thoroughness in the execution of his duties he rapidly gained the confidence of his employers, and at the time of his death held the position of Resident Engineer on the construction of an important part of the Alberta Central Ry., which included the building of the large bridge across the North Saskatchewan River at Rocky Mountain House, Alta. He was a young man of sterling character with bright prospects for the future; and he had made many genuine friends among his professional associates. [From J. Grant MacGregor, M. Can. Soc. C. E., Chief Engineer of the Alberta Central Ry., Red Deer, Alta.]

Everett F. Morse, M. Am. Soc. M. E., Secretary of the Morse Chain Co., Ithaca, N. Y., a distinguished mechanical engineer and inventor, died at his home in Ithaca, Nov. 11. He was born at Ithaca, June 28, 1857. When only 16 years of age he patented an improvement on the horse-drawn Lag rake and made good use of the earnings from his first invention to supplement other efforts to give him an education. He attended Cornell University in 1875 and, after being out for

several years, graduated in 1884 with the degree of Mechanical Engineer. After spending some time at Algona, Iowa, where he was manager of a flax mill, he returned to New York State and settled at Trumansburg. Here in 1893 he patented the Morse rocker-joint chain for bicycles and in conjunction with his brother, F. L. Morse, founded the Morse Chain Co. and began the manufacture of bicycle chains. The correct mechanical principle embodied in this chain, as well as its novelty, attracted immediate attention and eventually secured for the company a profitable business which lasted until the phenomenal slump in the bicycle trade about 1897. In the meantime, his brother, Frank L. Morse, who has been the active manager of the chain company for the past 13 years, developed the present type of silent chain for power purposes and during 1906 built the new plant at Ithaca where the business has grown from small beginnings to its present proportions. At the time of his death, Mr. Morse was a director and also Secretary of the Morse Chain Co., but for some years past he had devoted himself very largely to his heat-gage inventions and to various public duties in which he was most active and efficient. The Morse thermo gage, which Mr. Morse invented and patented in 1900, is a device for the measurement of the temperature of steel. This invention won him much distinction at home and abroad, and the device was adopted both by the United States and German Bureaus of Standards. In recognition of the high mechanical merit of the rocker-joint chain and thermo gage, Mr. Morse was awarded medals by the Franklin Institute.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Dec. 1-2. Annual meeting in New York Secy., W. H. Reed, 154 Nassau St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 2-5. Annual meeting in New York. Secy., Calvin W. Rice, 29 W. 39th St., New York City.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS.
Dec. 8-11. Annual meeting in New York. Secy., Percy H. Wilson, Land Title Bldg., Philadelphia, Penn.

SAND-LIME BRICK ASSOCIATION.
Dec. 9-10. Annual meeting at Harrisburg, Penn. Secy., W. E. Plummer, Jr., 211 Fillmore Ave., Buffalo, N. Y.

AMERICAN ROAD BUILDERS' ASSOCIATION.
Dec. 9-12. Annual convention at Philadelphia, Penn. Secy., W. H. Tolman, 29 W. 39th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Dec. 10-13. Annual meeting in New York. Secy., J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Dec. 11-12. General meeting in New York. Secy., D. H. Cox, 29 W. 39th St., New York City.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Dec. 29-31. Seventh annual convention at Chicago, Ill. Secy., I. W. Dickerson, Urbana, Ill.

MINING AND METALLURGICAL SOCIETY OF AMERICA.
Jan. 13. Annual meeting at New York City. Secy., W. R. Ingalls, 505 Pearl St., New York.

AMERICAN WOOD PRESERVERS' ASSOCIATION.
Jan. 20-22. Tenth annual convention at New Orleans, La. Secy., F. J. Angier, Timber Preservation Co., Baltimore, Md.

Sanitary Officers of the State of New York—The general subject of the 13th annual conference, now being held (Nov. 19-21) at Utica, N. Y., is the "Powers and Duties of Health Officers."

Society of Naval Architects and Marine Engineers—The preliminary program of the 21st general meeting to be held at the Engineering Societies Building, Dec. 11-12, includes the following papers: "Relative Resistance of Some Models with Block Coefficient Constant and Other Coefficients Varied," by Naval Constructor D. W. Taylor, U. S. N.; "Safety of Passenger Ships at Sea," by G. W. Dickie; "Structure of Vessels as Affected by Demand for Increased Safety," William Gatewood; "Stability of Life Boats," by Prof. H. A. Everett; "Diesel Engine in Marine Propulsion," by John Reid; "Evolution of the Lightship," by G. C. Cook; "Influence of National Policies on Ships Design," by Captain W. L. Rogers, U. S. N.; "General Organization of a Navy Yard," by Captain L. S. Van Duzer, U. S. N.

New England Water-Works Association—A meeting was held at Hotel Brunswick, Copley Sq., Boston, Mass., on Nov. 12. A paper was read on "Cleaning Water Mains in Hartford, Conn.," by Caleb Mills Saville, Chief Engineer, Board of Water Commissioners, Hartford, Conn. An abstract of this paper will appear in a later issue of "Engineering News." Other instances of the efficiency of water-main cleaning were given by various members. The second paper presented was "Water and Life," by Dr. Lawrence J. Henderson, of Harvard University. Dr. Henderson discussed water from the physiological, biological, physical and chemical points of view so interestingly and convincingly that the listeners were drawn to the conclusion that water is the most essential as well as the commonest substance in nature.

The topical discussion on the "Advisability of Securing Legislation for Making Water Bills a Lien Upon Property Supplied" was quite long and animated, and left no doubt as to the unanimity of opinion in favor of such legislation. The principal opposition to such a law in Massachusetts has come from real-estate operators. Robert J. Thomas, Superintendent of the Water-Works, Lowell, Mass., gave a brief history of previous attempts to have such a law passed by the Massachusetts legislature. The introduction of water meters, which ordinarily are read quarterly, makes the collections more difficult and the number of bad bills larger than under the old tax methods. A committee of five, of which Frank E. Hall, of Worcester, Mass., is Chairman, was appointed to use the influence of the Association in securing legislation in the State of Massachusetts.

American Road Builders' Association—The tenth annual convention, to be held at Philadelphia, Dec. 9-12, will comprise eight sessions at which will be presented the following papers: (1) "Highway Officials, Their Duties and Powers," Col. E. A. Stevens, State Highway Commissioner, New Jersey; (2) "Division of Expense, Responsibility and Authority between Nation, State, County and Town," S. Percy Hooker, State Superintendent of Highways, New Hampshire; (3) "The Relation to Each Other of the Contractor, Engineer and Inspector," F. L. Cranford, Brooklyn, N. Y.; (4) "Details of Arrangements for the Use of Convict Labor," Joseph Hyde Pratt, Ph. D., State Geologist of North Carolina; (5) "Determination of the Amount of Realignment, Grading and Drainage to be Done in Connection with Road Improvement," S. D. Foster, M. Am. Soc. C. E., Chief Engineer, State Highway Department of Pennsylvania; (6) "Factors Governing a Proper Selection of Road or Street Pavement," L. R. Grabill, Superintendent of Suburban Roads, Washington, D. C.; (7) Eleven Ten-Minute Papers on the Details of the Construction of Various Kinds of Roads and Pavements; (8) "Unit Price and Lump Sum Contracts and Percentage Work," H. C. Hill, Engineer, Lane Construction Corporation, Meriden, Conn.; (9) "The Testing of Materials for Road and Street Construction," Prevost Hubbard, Division of Roads and Pavements, Institute of Industrial Research, Washington, D. C.; (10) "Sub-Organization for Securing Efficient Maintenance," J. N. Carlisle, State Highway Commissioner of New York; (11) "General Methods of Repairs and Renewals," A. W. Dean, M. Am. Soc. C. E., Chief Engineer, Massachusetts Highway Commission; (12) "Bituminous Surface Treatment and Dust Prevention," Wm. H. Connell, M. Am. Soc. C. E., Bureau of Highways and Street Cleaning, Philadelphia, Penn.

The Street Railway and Light Railway Congress will hold its next meeting at Budapest in August, 1914. This congress is held under the direction of the International Association of Tramways and Light Railways, which has its offices at Brussels, Belgium. The preliminary list of subjects to be considered is as follows:

1. The development of residential districts in relation to transportation facilities and fares. Mr. Duval-Arnould, City Councillor, Paris, and Dr. Kuhles, City Councillor, Munich.
2. Rail corrugation. Mr. Busse, Chief Engineer of the Tramways Co., Berlin, and Mr. Resal, Electric Tramways & Omnibus Co., Bordeaux.
3. Rails and wheels, including the relation of the sections of rail heads, wheel tires and wheel flanges. Also the use of special rails and guard rails on curves. Mr. Bacqueyrisso, Chief Engineer of the Tramways & Omnibus Co., Paris, and Mr. Minorini, Engineer of the Municipal Tramways, Milan.
4. Roller bearings and ball bearings for axles of motor cars and trail cars. Mr. Largiader, Municipal Tramways of Zurich, Mr. Schoerling, Chief Engineer of the Tramways of Hanover, and Mr. Tobias, Superintendent of Shops of the Budapest Electric Tramways.
6. Transfer of rolling-stock between lines having different gage of track. Mr. Sapin, of the Central Electric Railway & Tramway Co., Paris.
7. Joint operation of a section of line by different companies. Mr. Carnevali, Chief Engineer of the Tramways of Turin.
8. Locomotives for light railways, and the use of superheaters on such engines. Mr. Hamelink, of the Netherlands Tramways Co., Utrecht, and Mr. de Soignie, of the Local Railways Co. of Andenne.
9. Underground-feeder systems, and the use of aluminum for electric conductors. Mr. Sekutowicz, Lyons Railway & Tramway Co.
10. The three-wire distribution system for electric railways, with higher voltage for suburban than city lines. Mr. Sieber, Nuremburg Tramways.
11. Comparison of different systems for transforming high-tension alternating current to direct current. Mr Dalrymple, Glasgow Corporation Tramways, and Mr. Sarratt, of Brussels.